RCA

ham tips

May 1969 | Volume 29 Number 1

HAM-BAND CHARTS

Covering FCC Allocations, Sub-Allocations, and Authorized Emissions from 3.5 to 450 MHz

By L. W. Aurick, K3QAX/W2QEX
RCA Electronic Components*

The return to incentive licensing on November 22, 1968 places even greater emphasis upon the Federal Communications Commission requirement that amateurs be familiar with all frequency assignments. No longer is it sufficient to know just the band edges. The amateur who plans any mobility around the various bands had best equip himself with either an Extra Class license or the charts on the following pages. Even with an Extra Class license, he may still find the charts useful as a guide to where his friends went.

Charts 1 and 2 cover all amateur frequency assignments up to 450 MHz, with the exception of the 1.8 to 2.0 MHz allocation. The 160-meter band is divided into eight "sub-bands," and operation in each of the 50 states and U. S. possessions is limited to a few of these. Maximum DC plate input power varies from day to night. A1 and A3 emissions are authorized, and there are no privileged segments. Because the regulations covering "top band" are subject to change without hearing (whenever the Commission shall determine such action necessary in view of the priority of the LORAN-A radionavigation system), it is suggested that interested amateurs consult the nearest FCC District Office for details governing their particular area.

Because of their limited scope, Novice Class privileges are not shown. They are as follows: radiotelegraph (A1) operation only, 3.7 to 3.75 MHz; 7.15 to 7.2 MHz; 21.1 to 21.25 MHz; and 145.0 to 147.0 MHz — using all authorized radiotelegraph emissions.

Technician Class licensees may use all emissions authorized between 50.1 and 54.0 MHz and between 145.0 and 147.0 MHz, as well as all amateur frequencies and emissions authorized above 220.0 MHz.

Emission Limitations

Type AØ emission may be used for short periods of time, even where not specifically designated, for test and other experimental purposes.

On frequencies below 29.0 MHz and between 50.1 and 52.5 MHz, the bandwidth of an F3 emission may not exceed that of an A3 emission having the same audio characteristics.

*Lancaster, Pennsylvania

Chart 1: Amateur Bands

(Showing Sub-Allocations and Authorized Emissions From 3.5 to 29.7 MHz)

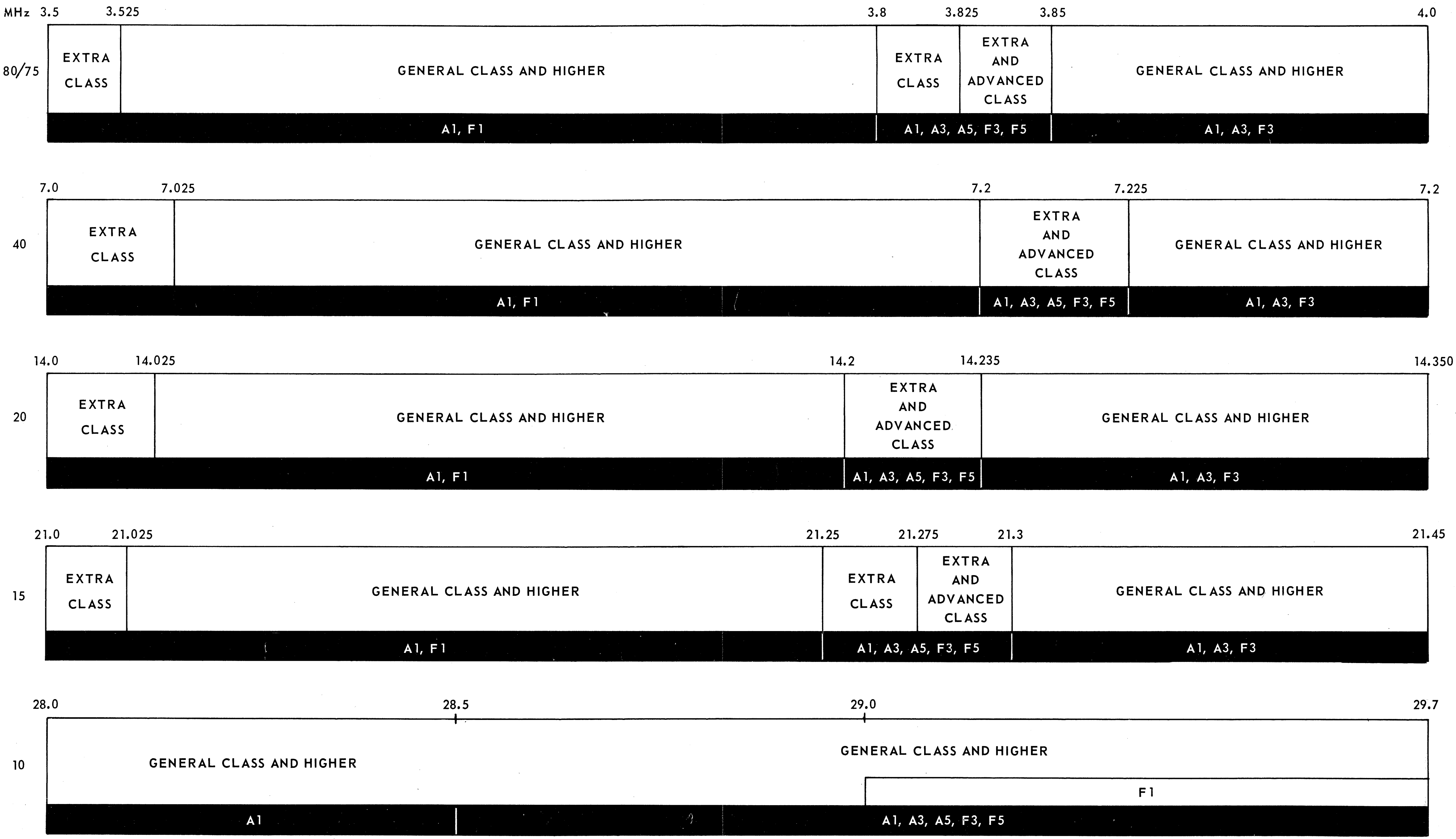
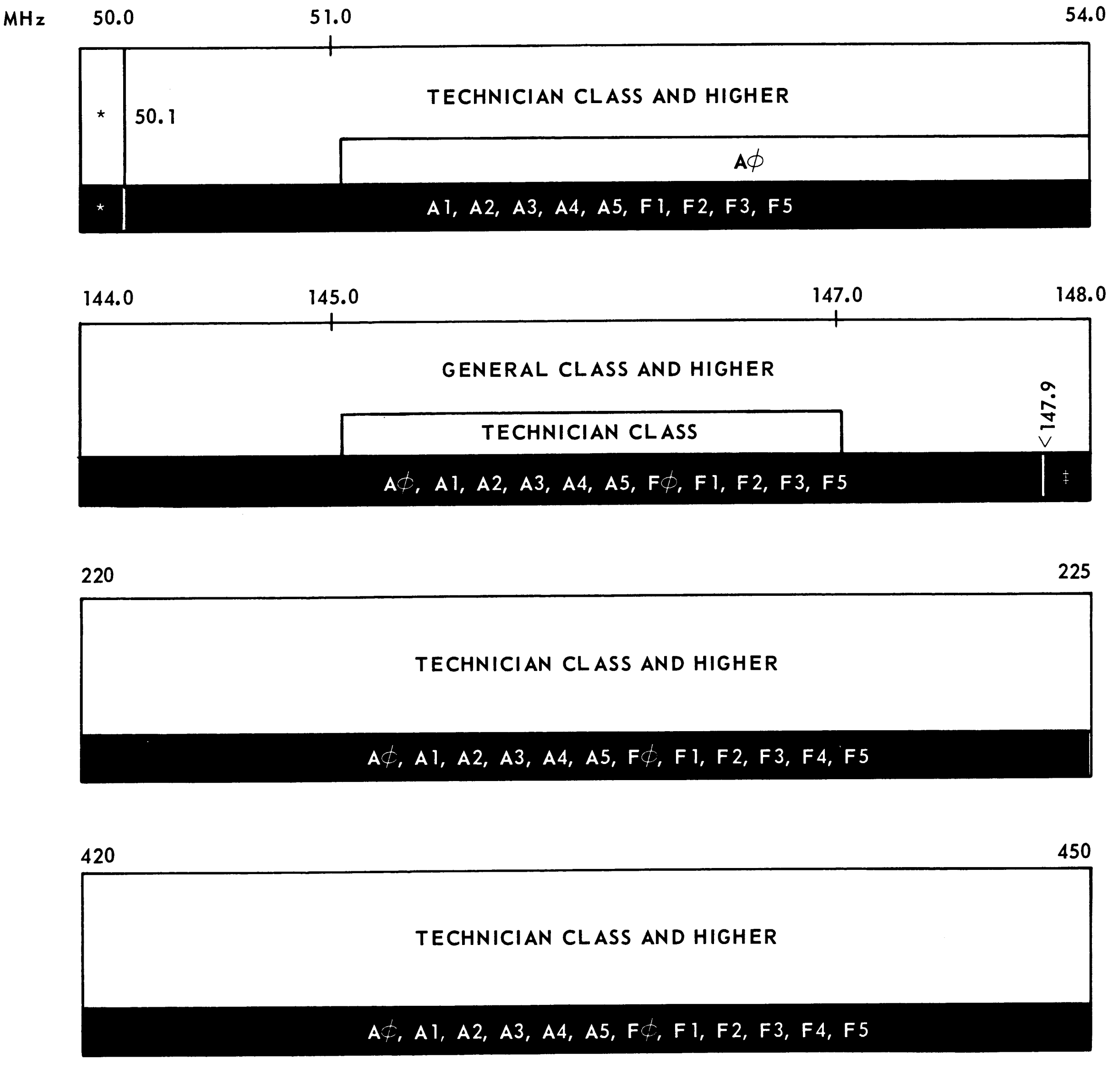


Chart 2: Amateur Bands

(Showing Sub-Allocations and Authorized Emissions From 50 to 450 MHz)



* EXTRA AND ADVANCED CLASS — A1 ONLY

‡ GENERAL CLASS AND HIGHER — A1 ONLY

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Charts

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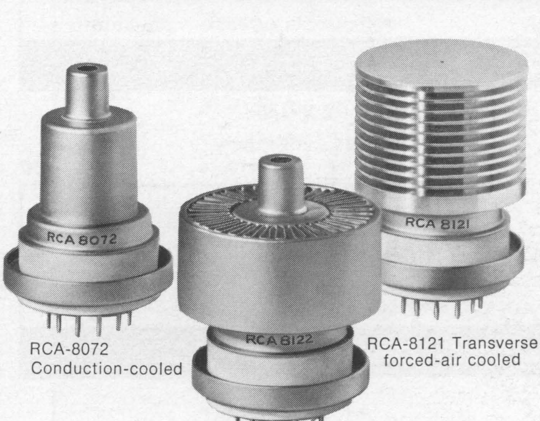
When you look into your final, look for the RCA-8122



RCA-8072 Conduction-cooled

RCA-8122 Axial forced-air cooled

RCA-8121 Transverse forced-air cooled

Not just because it's an RCA beam power tube, either! We think you deserve power and reliability—and we know, just as leading manufacturers of communications equipment know, that the RCA-8122 has more of both. For a starter, it has more than 50% greater dissipation capability than older tubes of comparable size...and delivers up to full rated output with as little as 5 Watts drive all the way to UHF. It gives you design options, too; the RCA-8122 is usable with coaxial, strip-line, or conventional lumped component tank circuit.

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November 1969 | Volume 29 Number 2

A Precision Three-Mode Voltage Calibrator

By D. W. Nelson, WB2EGZ
RCA Defense Electronic Products*

Do you remember the last time you calibrated your VTVM? You don't? Well, you probably can recall the date you needed to know the deflection sensitivity of your 'scope.

You can easily determine the sensitivity of your equipment and improve its accuracy with the aid of the three-mode voltage calibrator described by WB2EGZ in this issue. As an added bonus to building this useful instrument, you will gain a practical working knowledge of RCA's popular-priced CA3018 and CA3047A integrated circuits, as well as many valuable pointers on the versatile metal-oxide-semiconductor (MOS) field-effect transistor.

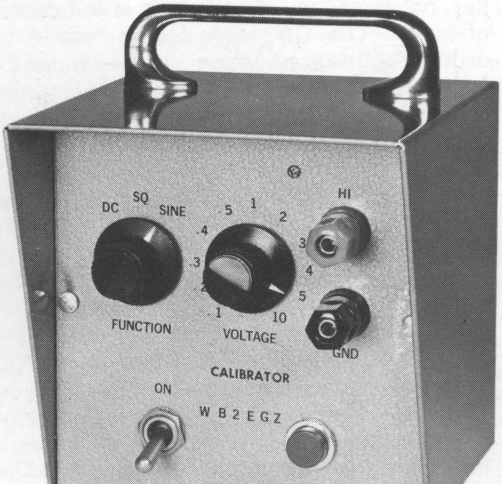


Figure 1: Exterior view of three-mode voltage calibrator constructed by WB2EGZ. A rather sophisticated circuit has been compressed into a 5-by-5-by-5-inch "cowl box."

Using the least complex circuit possible, the author has developed a voltage calibrator offering a choice of three outputs: DC, an RMS sine wave, and a peak-to-peak square wave. Unlike some other calibrators, no manipulation or guesswork is involved in using the AC (RMS) mode of this calibrator.

Circuit Description

The calibrator is best described in terms of the block diagram shown in Figure 2 and the schematic diagram shown in Figure 3. Two 1-kHz oscillators (a sine wave and a square wave) and a DC level form the basic generators of the correct waveforms. Any of the three modes may be selected and fed to a follower amplifier which prevents loading of the generators. The precision of the instrument is established at the output of the follower by a voltage divider. This is the only place in the circuit where precision parts are used. If an AC output were not

*Camden, New Jersey

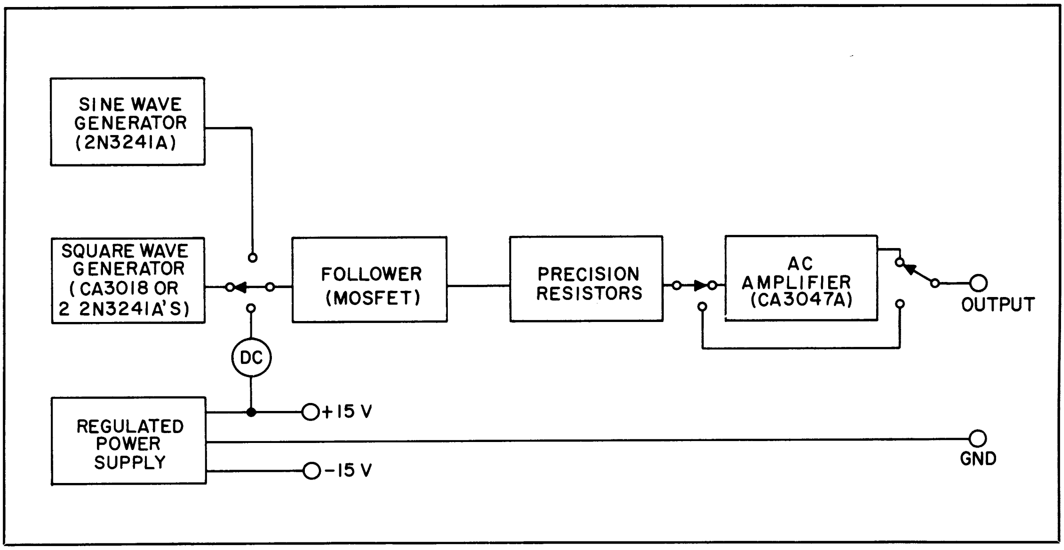


Figure 2: Block diagram of three-mode voltage calibrator.

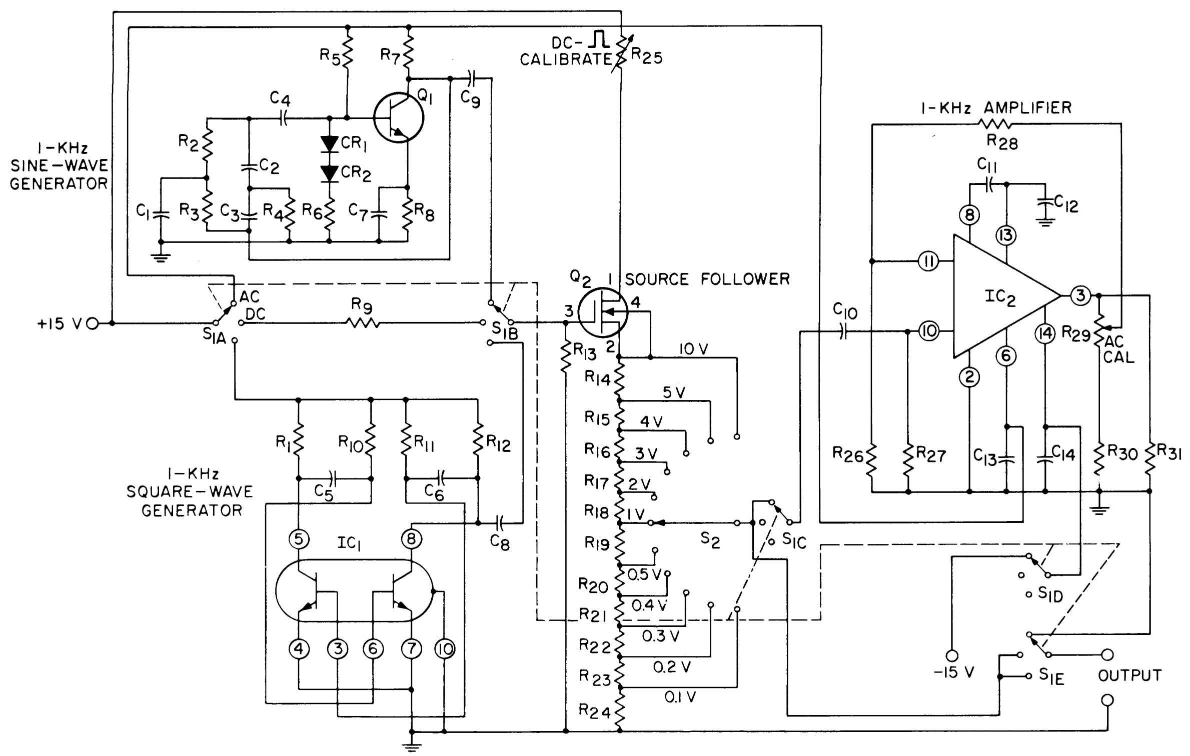
needed, the circuit could terminate here.

The requirement for an alternating-current sine wave complicates the design appreciably because the basic generators cannot provide an undistorted wave form of sufficient amplitude. Remember that the peak-to-peak amplitude of a sine wave is 2.83 times the RMS value. Furthermore, the signal must average zero volts to make most voltmeters read correctly. These requirements have been met by using an operational amplifier of fixed gain in the AC section of the calibrator.

The three-mode calibrator requires regulated power supplies to maintain stability. The dual supply used with the calibrator is shown in Figure 4. A positive 15 volts powers the generators and the follower, but the AC amplifier uses a negative 15-volt supply as well. The 30-volt total permits generation of a 28.3-volt peak-to-peak undistorted output for the 10-volt RMS level. The use of positive and negative supplies permits the centering of the amplifier output around zero.

Two types of integrated circuits, or "IC's," are employed in the calibrator. One — the RCA-CA3018 — contains four transistors, only two of which are used. The second IC—the RCA-CA3047A—is a direct-coupled amplifier that contains both resistors and transistors. The original intent was to combine the square-wave generator with the sine-wave generator by using all the transistors in the CA3018. Due to certain temperature problems, however, it was impossible to maintain accuracy in the AC mode with this configuration. Hence, the sine-wave oscillator was redesigned to use a discrete transistor, type 2N3241A. Two of this same type transistor may be used in the square-wave generator, if desired, without adversely affecting calibrator performance. The method of connecting the discrete transistors in place of the CA3018 is shown in Figure 5. In the instance of the AC amplifier, however, any substitution is out of the question. The CA3047A seems "made to order" for this application, and combines 21 transistors and 14 resistors in a very sophisticated circuit. Can you imagine the size of this circuit if tubes — or even transistors — were used?

Thermal stability presented the greatest design problem in this project. Power-supply voltage was stabilized by using 1N5216 silicon diodes in series with the 1N965 regulator diodes. Second, the sine-wave oscillator, which utilizes a twin-T bridge circuit, was stabilized by using two more 1N5216's in the base-biasing network. The system used in the sine-wave oscillator could be improved. In its present form, it limits the thermal drift to 2 percent of the output voltage. Long-term stability would be better if the diodes and transistor were physically connected as they are in an IC. Nearly perfect stability is the boast of the CA3047A operational amplifier. There is a slight long-term drift in the source-follower MOS transistor circuit, but this is insignificant for most amateur applications of the



C_1, C_2, C_3, C_4, C_{12}, C_{103}, C_{104} — 0.01 microfarad, 50 volts, paper or ceramic tubular

C_5, C_6 — 0.022 microfarad, 50 volts, paper or ceramic tubular

C_7 — 2.2 microfarads, 6 volts, electrolytic

C_8, C_9 — 0.047 microfarad, 50 volts, paper or ceramic tubular

C_{10}, C_{11}, C_{13}, C_{14} — 0.1 microfarad, 50 volts, paper or ceramic tubular

C_{101}, C_{102} — 1,000 microfarads, 50 volts, electrolytic

CR_1, CR_2, CR_{101}, CR_{102}, CR_{103}, CR_{104}, CR_{107}, CR_{108} — RCA-1N5216 silicon diode

CR_{105}, CR_{106} — 1N965 regulator diode

F_1 — 1-ampere 3AG fuse

I_1 — NE51 Neon indicator bulb

IC_1 — RCA-CA3018 linear integrated circuit or two RCA-2N3241A silicon NPN transistors

IC_2 — RCA-CA3047A linear integrated circuit

Q_1, Q_{101}, Q_{102} — RCA-2N3241A silicon NPN transistor

Q_2 — RCA-3N128 or RCA-40467A or RCA-40468A single-gate MOS field-effect transistor

Q_{103}, Q_{104} — RCA-2N2613 germanium PNP transistor

Q_{105} — RCA-2N3053 silicon NPN transistor

Q_{106} — RCA-2N4037 silicon PNP transistor

R_1, R_{12} — 1.8 kilohms, ¼ watt, carbon

R_2, R_3 — 27 kilohms, ¼ watt, carbon

R_4, R_{102}, R_{103} — 2.7 kilohms, ¼ watt, carbon

R_5, R_{26}, R_{27} — 100 kilohms, ¼ watt, carbon

R_6 — 10 kilohms, ¼ watt, carbon

R_7 — 4.7 kilohms, ¼ watt, carbon

R_8 — 560 ohms

R_9 — 820 kilohms, ¼ watt, carbon (may be adjusted for precise agreement between DC and square wave)

R_{10}, R_{11} — 39 kilohms, ¼ watt, carbon

R_{13} — 1 megohm, ¼ watt, carbon

R_{14} — 2 kilohms, ¼ watt, 1%, deposited carbon or metal film

R_{15}, R_{16}, R_{17}, R_{18} — 400 ohms, ¼ watt, 1%, deposited carbon or metal film

R_{19} — 200 ohms, ¼ watt, 1%, deposited carbon or metal film

R_{20}, R_{21}, R_{22}, R_{23}, R_{24} — 40 ohms, ¼ watt, 1%, deposited carbon or metal film

R_{25}, R_{29} — 1 kilohm miniature pot (Mallory MTC-L1 or equiv.)

R_{28} — 330 kilohms, ¼ watt, carbon

R_{30} — 1.5 kilohms, ¼ watt, carbon

R_{31} — 100 ohms, ½ watt, carbon

R_{101} — 120 kilohms, ½ watt, carbon (not necessary with 120-volt indicator assemblies)

R_{104}, R_{105} — 2.2 kilohms, ¼ watt, carbon

R_{106}, R_{107} — 1.5 kilohms, ½ watt, carbon

S_1 — 5-pole, 3-position rotary (Centralab PA-2015 or equiv.)

S_2 — 1-pole, 11-position rotary (Centralab PA-2000 or equiv.)

S_{101} — SPST toggle

T_{101} — power transformer (Triad F91X or equiv.)

Miscellaneous — Cowl box (Bud SC-2133 or equiv.); heat sink (Thermalloy 2225-B or equiv.); binding posts; and 3AG fuse holder.

Figure 3: Schematic diagram and parts list of WB2EGZ calibrator.

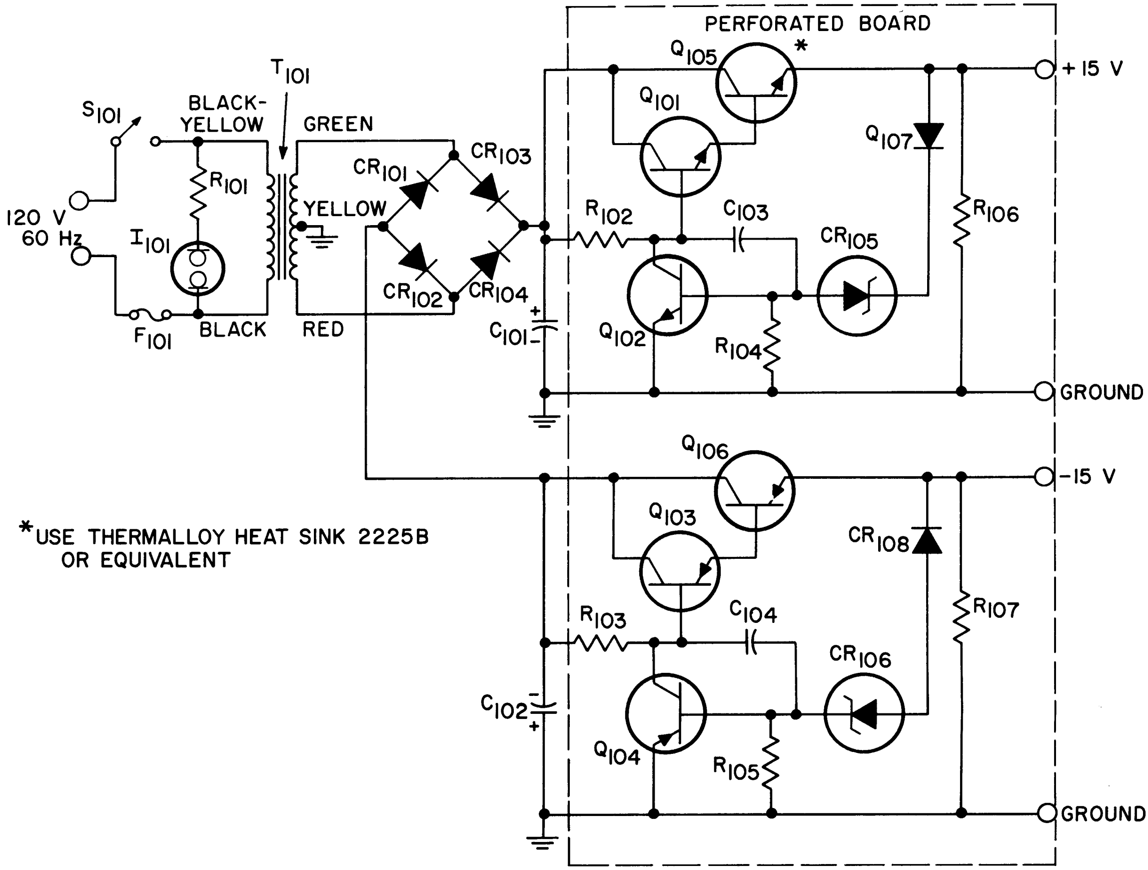


Figure 4: Schematic diagram of ±15-volt power supply.

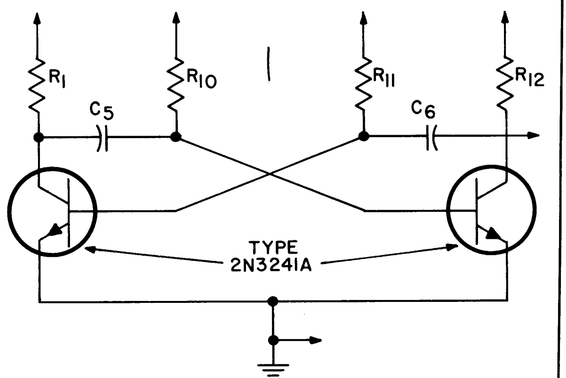


Figure 5: Schematic diagram of square-wave generator as it would appear if constructed with transistors in place of the CA3018 integrated circuit.

calibrator. No special compensation was added to the follower or square-wave generator portions of the calibrator.

Construction

Construction of the calibrator in a Bud "cowl box" 5 inches square keeps its size to a minimum (see Figures 6, 7, and 8). In some instances, however, builders may prefer larger cases, particularly if the small ceramic capacitors suggested here are not available. Larger components are acceptable and their placement is not critical, provided that signal leads from the 60-Hz AC field are adequately shielded. In the calibrator described here, all such leads carrying calibration signal information have been shielded and the shields connected at a common point near the CA3047 (see Figure 8). This arrangement follows standard de-

sign practice. It is not known whether unshielded leads would introduce significant hum.

The perforated boards containing power-supply regulators and signal-generator circuitry are wired and tested before final placement. It is expedient to also pre-wire the rotary switches as completely as possible. Dimensions for front and rear panels, bottom section, and all drill holes are shown in the chassis layout provided in Figure 9.

Caution: The device used as the follower amplifier in the calibrator is an MOS field-effect transistor. Transistors of this type are shipped with a thin wire wrapped around the leads to prevent accidental burnout. This wire should not be removed until the device is connected into the circuit. Although the author used a small socket to facilitate changes during construction of the calibrator (see Figures 6 and 8), soldering of leads is "good practice" provided that the leads are kept shorted until soldering is complete.

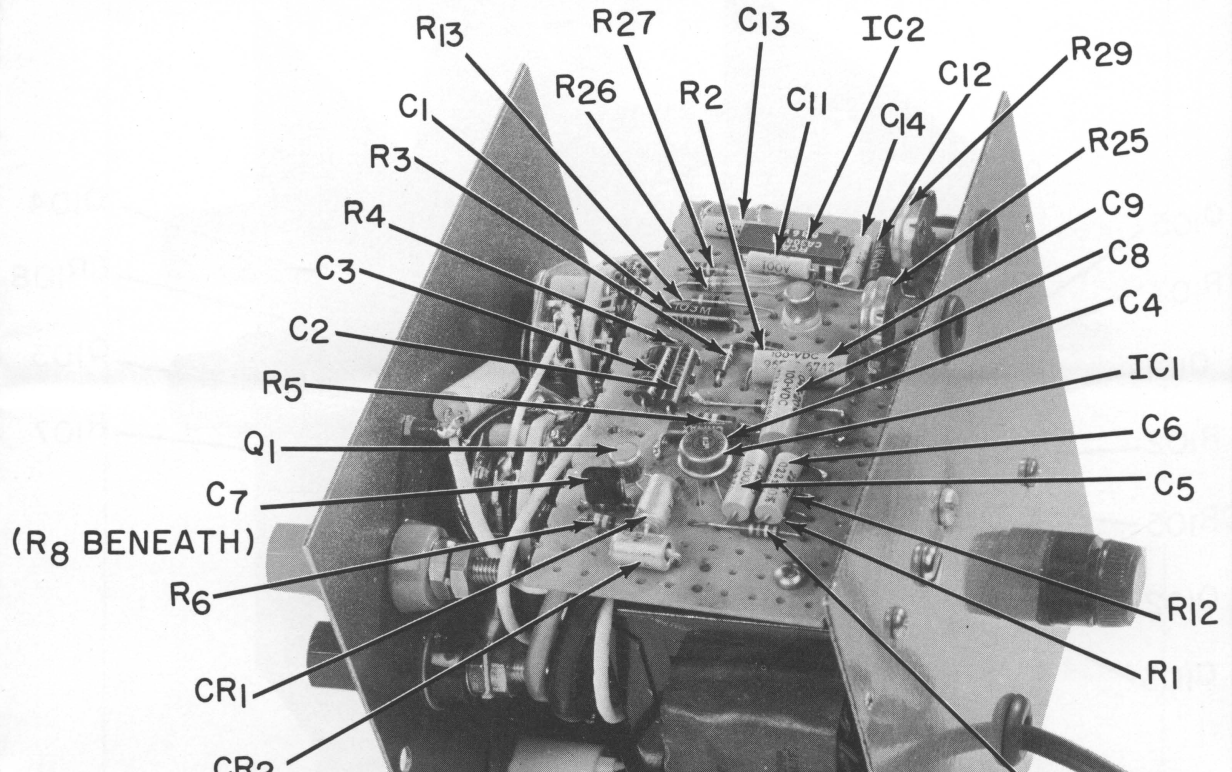


Figure 6: High-level view of right side of calibrator showing layout of the generator-amplifier board. Note that the DC and AC calibration controls are mounted so adjustments can be made by a screwdriver through the grommets on the rear of the chassis. The MOS field-effect transistor, located near these controls, is mounted in a socket. A builder who chooses to wire the MOSFET directly must take the precaution of keeping all leads shorted together until the circuit wiring is complete.

Calibration

In order for the calibrator to function accurately, each of its sections must be adjusted to agree with some voltage standard. If you're a stickler for precision, finding a standard may be the hardest part of your project. A new and unused "D" cell, such as an RCA-VS036 1.5-volt battery, should measure 1.55 volts and is a practical standard for DC calibration. This cell is used to calibrate an oscilloscope to 0.5 volt per division; total vertical deflection is slightly more than 3 divisions. The 'scope is then attached to the calibrator which is set for 1 volt DC. R_{25} is adjusted for a deflection of 2 divisions, or 1 volt. At this time, it would be wise to try all voltage settings of the calibrator to be sure the 1-percent resistors are correct.

The square-wave calibration has been made at the same time as the DC calibra-

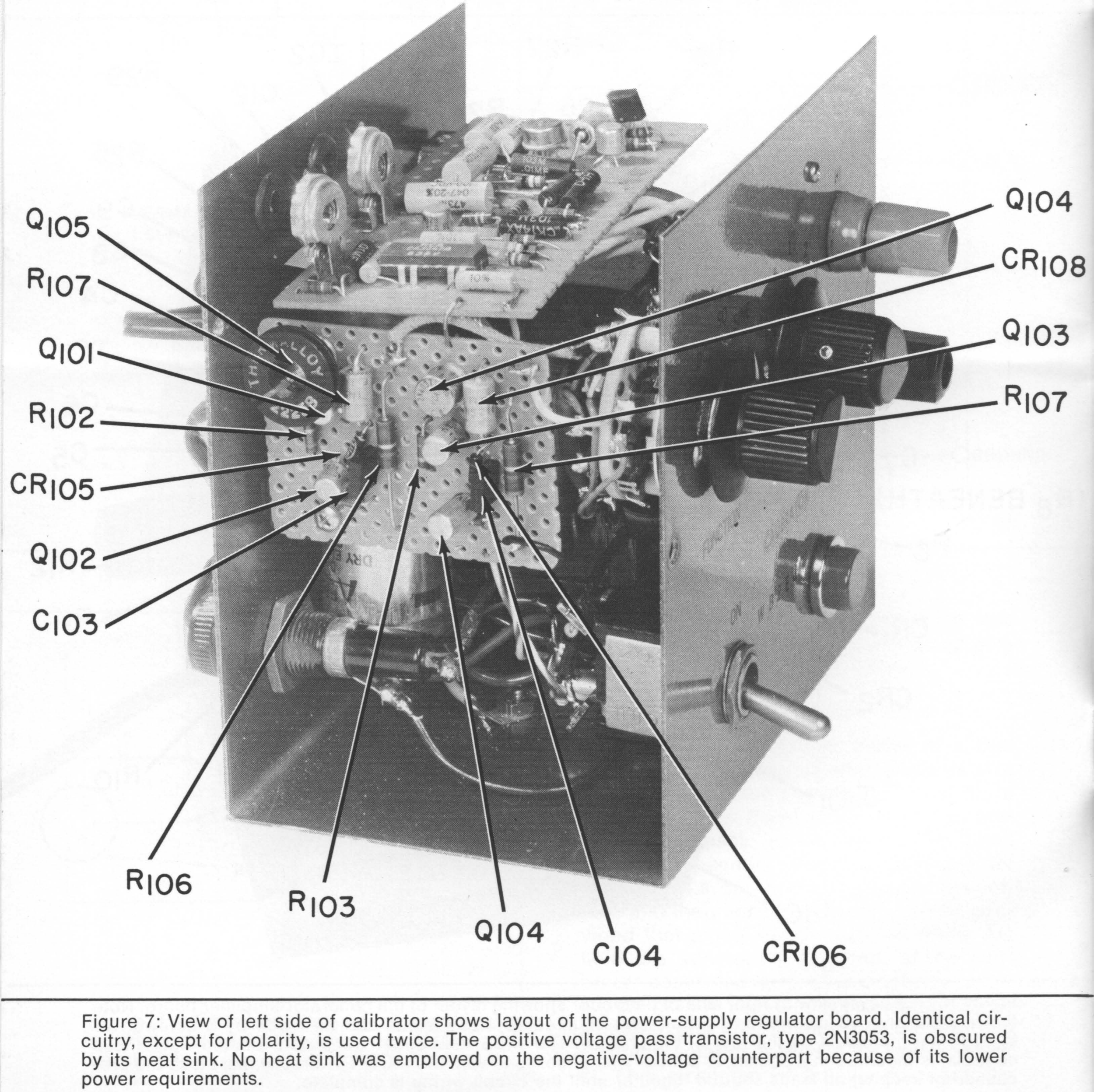


Figure 7: View of left side of calibrator shows layout of the power-supply regulator board. Identical circuitry, except for polarity, is used twice. The positive voltage pass transistor, type 2N3053, is obscured by its heat sink. No heat sink was employed on the negative-voltage counterpart because of its lower power requirements.

tion. Unfortunately, AC calibration requires a second adjustment. This adjustment is accomplished by trimming the gain of the CA3047A amplifier. This gain is needed to increase the peak-to-peak voltage to 2.83 times the value shown on the voltage switch. For the 1-volt setting, the sine wave is set by R_{29} to read 2.83 volts peak-to-peak. Even though the other voltage positions have been checked, AC on the 10-volt position must be tried to be sure the sine wave is not distorted. Should it be distorted or clipped due to differences in components, the output of the sine-wave oscillator must

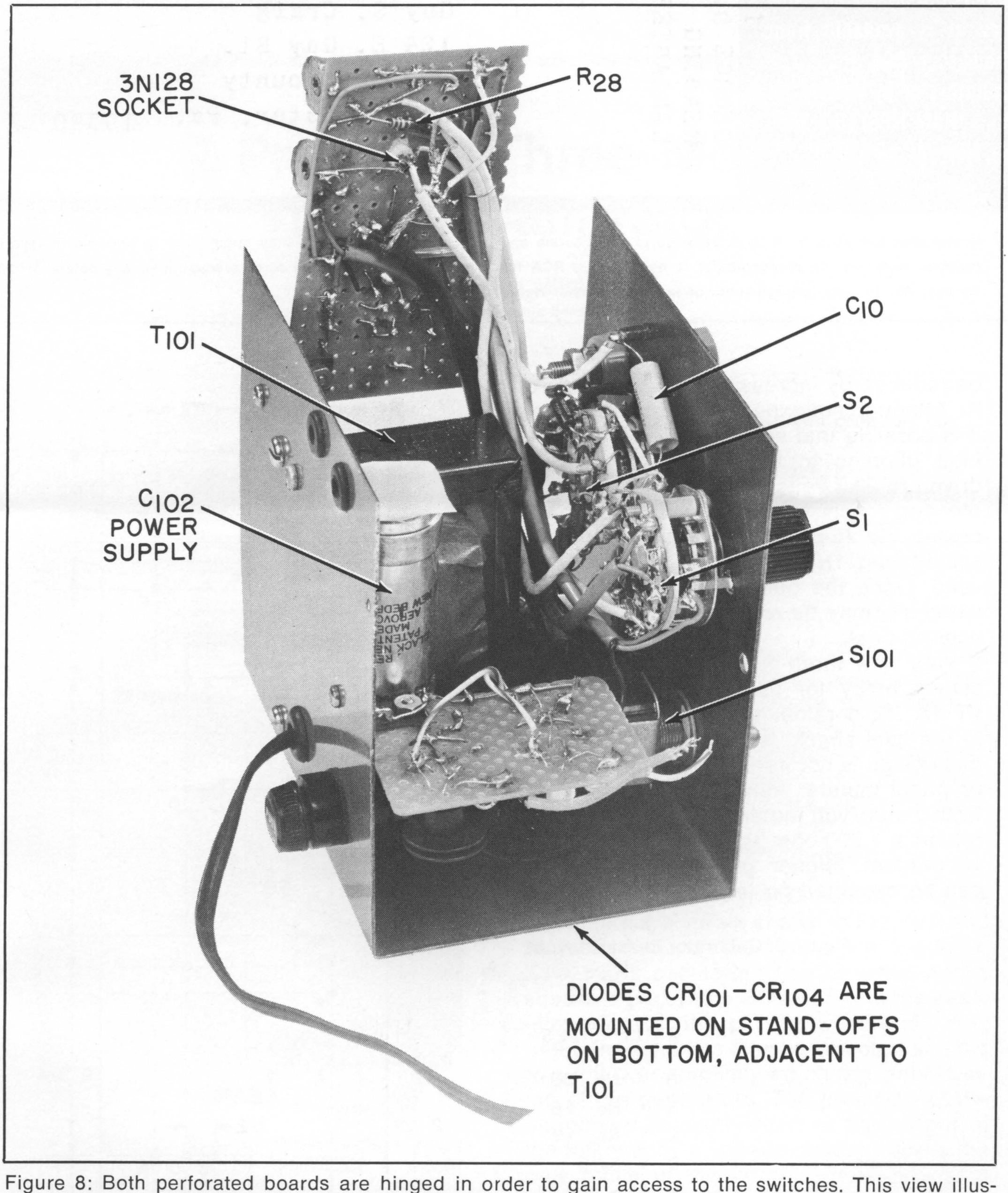
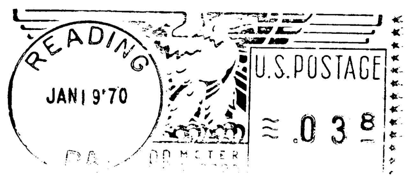


Figure 8: Both perforated boards are hinged in order to gain access to the switches. This view illustrates how the shielded cables were installed between the perforated boards and the switches. The square piece of plastic insulation mounted on the large capacitor in the background insulates the capacitor from the wiring of the generator-amplifier board. Any suitable insulating material may be used, of course.

RCA



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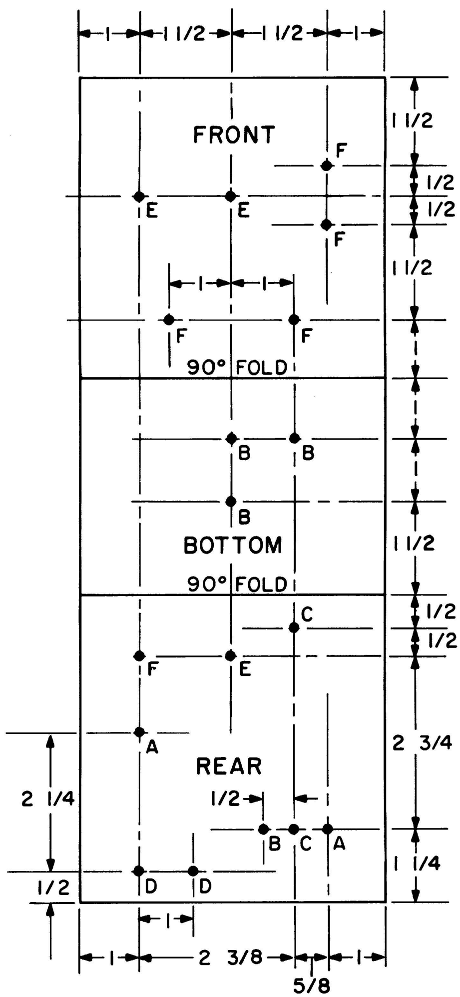
be reduced by increasing the resistance of R_8. Although not experienced by the author, it is possible that some CA3047A's will exhibit clipping in the output stage when driven to 28.3 volts peak-to-peak. The simple correction for this problem is to increase the 15-volt supplies to 16 volts by substituting 1N966's for the 1N965's now used. Once the output distortion is eliminated, R_{29} may be readjusted for 28.3 volts peak-to-peak.

Your new three-mode voltage calibrator stands ready for use with the 'scope or VTVM. It's a rather sophisticated addition to the ham shack, isn't it? Remember that this design is not intended to check VOM's or panel meters. Although the error on a 20,000-ohm/volt meter is negligible, the error on a 1,000-ohm/volt DC meter will be 10 percent. Higher percentages of error can be expected on less sensitive meters.

Figure 9: Calibrator chassis layout.



DRILL SIZES

A = No. 33
B = No. 28
C = No. 19
D = 5/16
E = 3/8
F = 1/2

ALL DIMENSIONS IN INCHES.

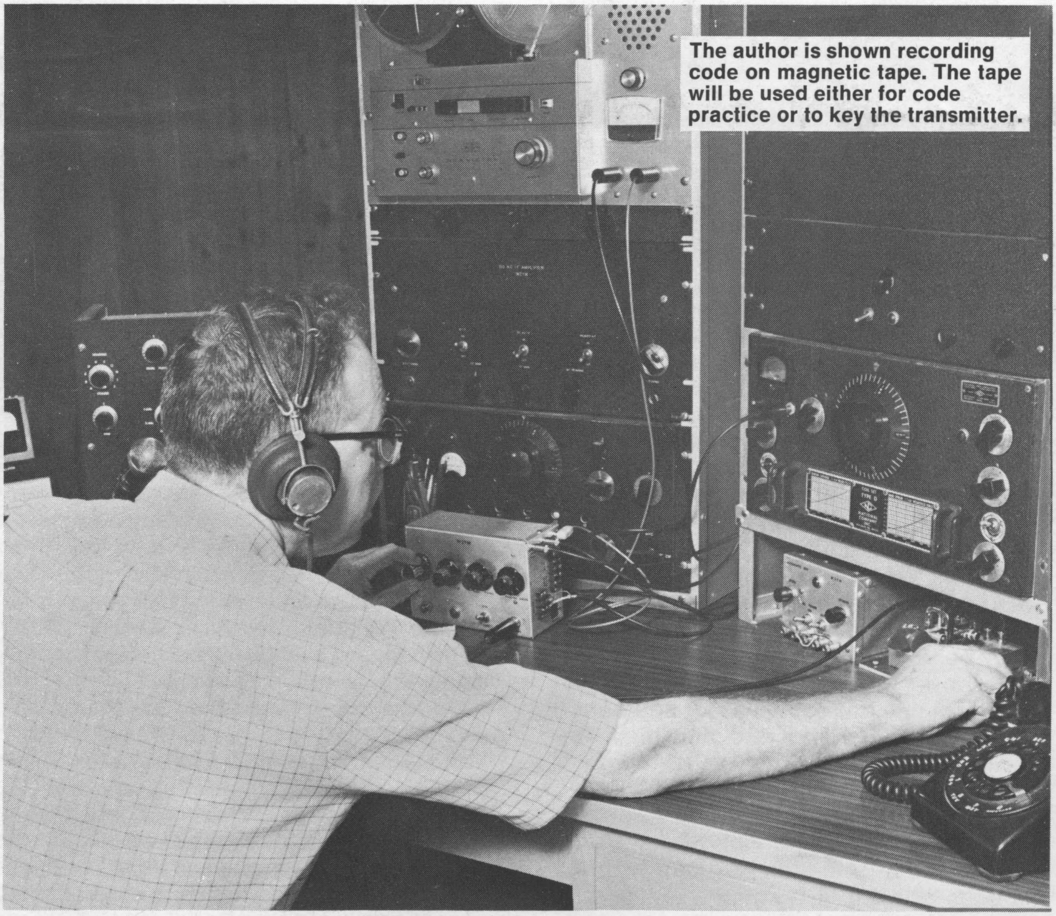
ham tips

December 1969 | Volume 29 Number 3

A Magnetic-Tape Keying System for Code Recording and Transmission

By George D. Hanchett, W2YM

RCA Electronic Components*



The author is shown recording code on magnetic tape. The tape will be used either for code practice or to key the transmitter.

*Solid-State Engineering, Somerville, New Jersey

Equipment for mechanically keying a transmitter by means of a tape recorder can be a desirable addition to the ham shack. Not only can it be used for "skeds" and for automatic-calling in contests, but to provide code instruction as well. Code can be recorded at one speed and played back at another; thus it is possible to double or even halve the original rate.

Actually more than a simple keyer, the W2YM magnetic tape-to-code converter can also be used to record voice transmissions. As an additional feature, its side-tone oscillator can be combined with the mixer to form an excellent code-monitoring device.

The basic elements of the system consist of a tape recorder, tape-to-relay converter, keying relay, code oscillator, and key. No alterations are required of the tape recorder and use of the converter is extremely simple. The code oscillator is "built in" so that pitch will not vary with code speed. The parts cost of the equipment — excluding the tape recorder — totals about $30.

Figure 1: The W2YM magnetic-tape keyer control, or "Keyer." All components are contained within a 7-by-5-by-3-inch minibox with the exception of the power transformer.

The magnetic-tape keyer control, or "Keyer," illustrated in Figure 1 is relatively easy to build because there are no sensitive circuits and most of the components are contained on a single 3-by-6-inch circuit board.

For the benefit of the builder, this circuit board is presented in considerable detail. In Figure 2, it is shown as a full-size component diagram and drilling template and, in Figure 3, as a schematic diagram with accompanying parts list. The photographs in Figures 4 and 5 respectively show the board as a completed unit and as part of the Keyer following installation. The completed board and the additional components of the Keyer are mounted in a 7-by-5-by-3-inch aluminum box with spacers separating the circuit board from the aluminum enclosure. Figure 6 shows a schematic diagram of the complete Keyer.

The terminals shown in the photographs were made by bending No. 18 solid bare wire around a 3/16-inch rod and inserting the ends of each "U" through No. 58 drill holes in the board. After insertion, the ends of the wire terminals should protrude sufficiently from the underside of the board to permit point-to-point soldering of the connections with No. 22 plastic-coated wire. A printed circuit board can be used, of course, but only after some rearrangement of components to minimize the number of crossovers. In any case, No. 60 holes should be drilled to accommodate component leads.

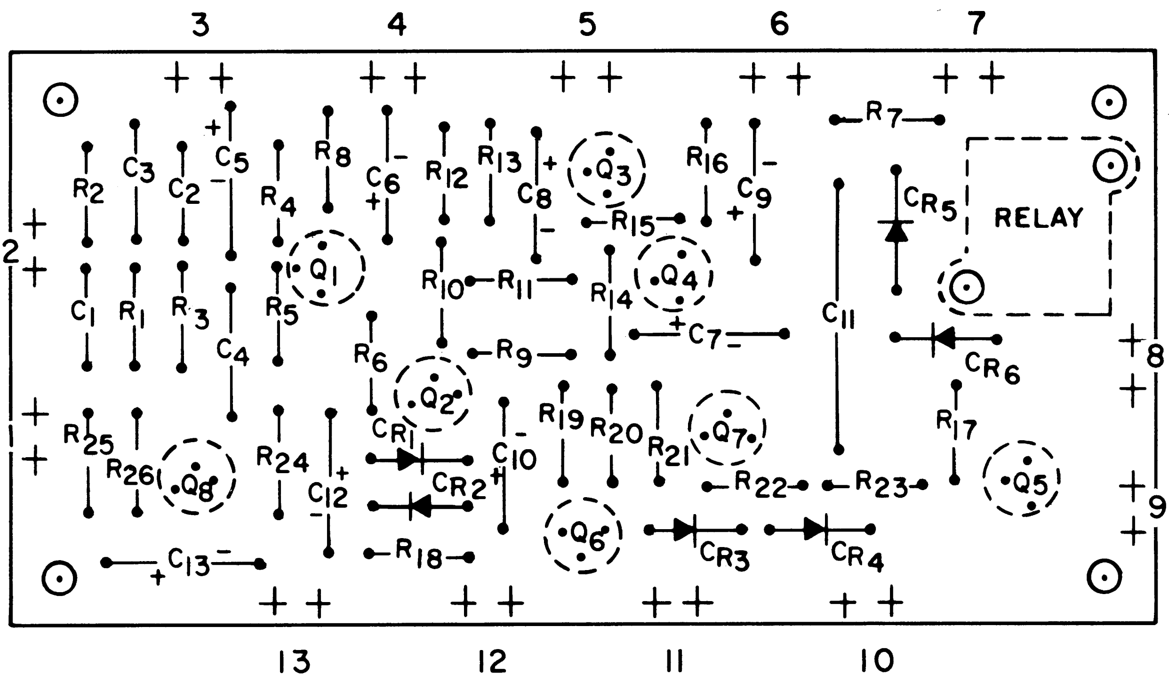
Keyer Connections

The Keyer is readied for operation by making the connections described below and illustrated in Figure 7.

First, connect the "Rcvr Output" jack, J_3, on the Keyer to the headphone jack on the communications receiver. Then connect shielded wire from the "Tape Input" jack, J_1, on the Keyer to the "Line or Aux" input on the tape recorder. If the recorder has a "Line or Aux" output jack, also connect shielded wire from that jack to the "Tape Output" jack, J_2, on the Keyer. If the tape recorder does not have a "Line or Aux" output, some modification of recorder wiring will be required prior to making this third connection (see Figure 8).

Next, connect the transmitter keying-relay contacts to the "Relay" terminals on the Keyer and plug in a hand or auto key at the "Key" jack, J_4. The magnetic-tape keyer control is now ready for use.

Note that both hand and auto keys can be connected simultaneously, if desired, by using the "Key" plug on the front of the Keyer for one key and the "Key" terminals on the side of the Keyer for the second key. Volume-controlled audio output is available through the "Phones" plug, J_5, on the Keyer, or through the receiver speaker (if the Keyer "Audio Output" terminals are reconnected to the receiver). The loudness of the signal in the phones is controlled by means of the "Phone Gain" control, R_3, on



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- + No. 58 DRILL (0.042 INCH)
- ⨀ No. 32 DRILL (0.116 INCH)

Figure 2: Circuit-board component-layout diagram and drilling template.

the Keyer. The loudness of the signal in the receiver speaker is controlled by the volume control on the receiver. The "Receiver" control, R_1, on the Keyer is the input volume control and varies the signal level in both phones and speakers simultaneously.

Keyer Operation

Figure 7 shows the interconnections of the entire magnetic-tape keying system.

To operate the Keyer, set the "Selector" switch to position No. 1 and tune in a strong, readable, CW signal. The "Receiver" control should be approximately in mid-position after this adjustment. In switch-position No. 1, the Keyer amplifier is connected directly to the receiver through mixer input No. 1, and to the side-tone oscillator through mixer input No. 2. Adjust the gain control on the tape recorder to the proper recording level. A VU meter is a valuable tool in determining this level and in producing good tapes. If the tape recorder being used does not have a VU meter, you can insert one into the circuit by use of the "Meter" plug on the side of the Keyer.

Next, depress the hand key and adjust the "Side Tone" control, R_2, so that the signal from the side-tone oscillator is at the same level as the incoming CW signal. The Keyer is now set to act as a monitor of incoming and outgoing signals and to permit manual keying of the transmitter and recording of both incoming and outgoing signals.

As a succeeding step, record some text on the tape with the "Selector" switch in position No. 1. Then rewind the tape, set the "Selector" switch in position No. 2 — the tape playback position — and confirm proper operation of the Keyer and recorder by listening to the playback. When the "Selector" switch is in position No. 2, the tape recorder output is connected to mixer

Figure 3: Schematic diagram and parts list of Keyer circuit board.

C_1, C_2 — 0.012 microfarad, 200 volts, paper

C_3 — 0.027 microfarad, 200 volts, paper

C_4 — 0.01 microfarad, 200 volts, paper

C_5 — 20 microfarads, 15 volts, electrolytic

C_6, C_8, C_{10} — 5 microfarads, 6 volts, electrolytic

C_7, C_9, C_{12} — 5 microfarads, 12 volts, electrolytic

C_{11} — 0.22 microfarad, 200 volts, paper

C_{13} — 5 microfarads, 25 volts, electrolytic for solid-state receivers; 0.5 microfarad, 400 volts, paper for tube-type receivers

CR_1, CR_2, CR_3, CR_4, CR_5, CR_6 — silicon rectifier, type 1N3193

Q_1, Q_2, Q_3, Q_4, Q_6, Q_7, Q_8 — transistor, type 2N3242A

Q_5 — transistor, type 2N2614

R_1 — 2,700 ohms, ½ watt

R_2, R_3 — 27,000 ohms, ½ watt

R_4, R_{25}, R_{26} — 100,000 ohms, ½ watt

R_5 — 22,000 ohms, ½ watt

R_6 — 6,800 ohms, ½ watt

R_7, R_{17} — 470 ohms, ½ watt

R_8 — 2,200 ohms, ½ watt

R_9, R_{10}, R_{18}, R_{24} — 1,000 ohms, ½ watt

R_{11}, R_{20} — 1,200 ohms, ½ watt

R_{12}, R_{13}, R_{19}, R_{21} — 10,000 ohms, ½ watt

R_{14} — 820 ohms, ½ watt

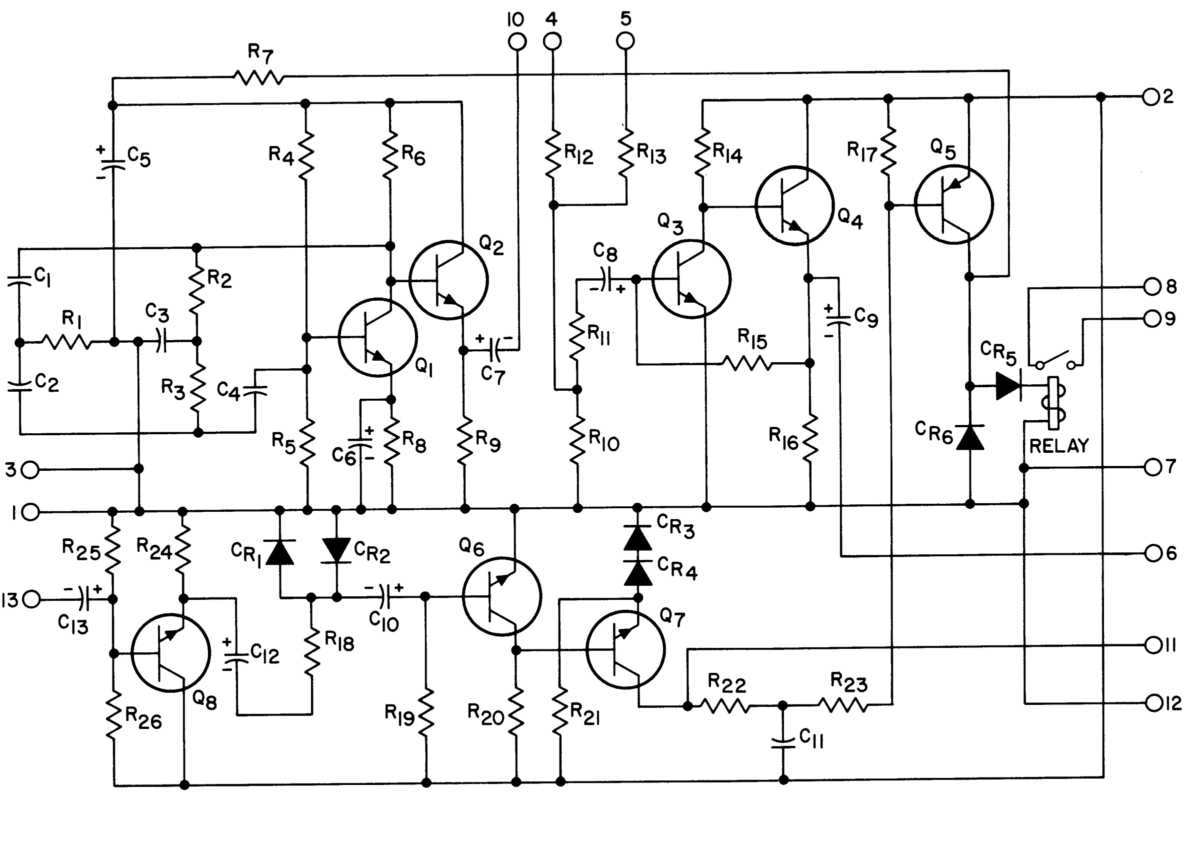
R_{15} — 120,000 ohms, ½ watt

R_{16} — 220 ohms, ½ watt

R_{22} — 680 ohms, ½ watt

R_{23} — 1,500 ohms, ½ watt

Miscellaneous — Relay, Potter and Brumfield type RS5D (12-volt coil) or equiv.



input No. 1 instead of to the receiver. Switch position No. 2 is used whenever taped material is to be checked.

In position No. 3, the selector switch connects the receiver to mixer input No. 1 and the amplifier output to the input of the audio keyer section of the Keyer. The output of the side-tone oscillator is then impressed upon the tape recorder so that the tone recorded on the tape is that of the side-tone oscillator and not that of the actual incoming signal. The transmitter may be manually keyed and monitored when the "Selector" switch is in this position.

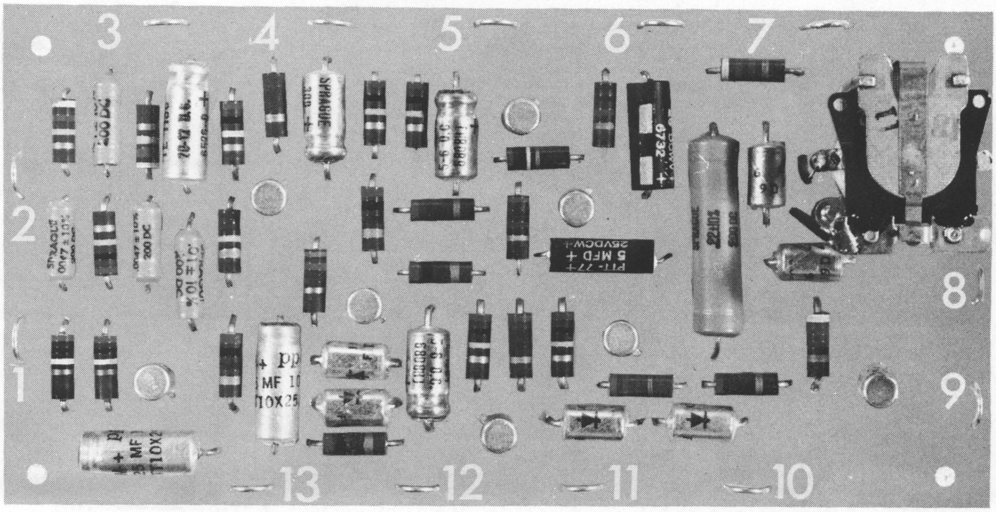


Figure 4: Completed circuit board.

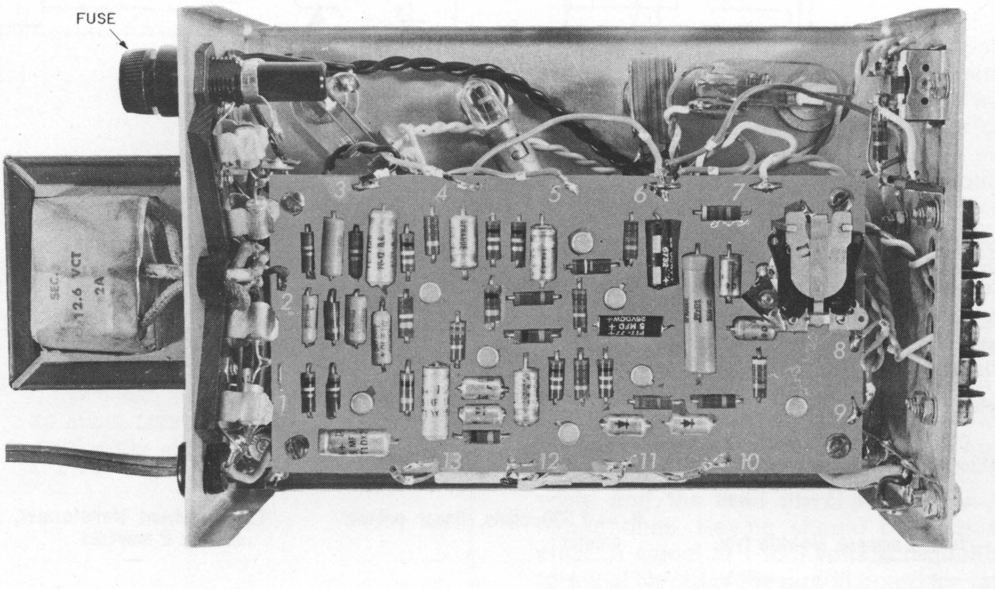
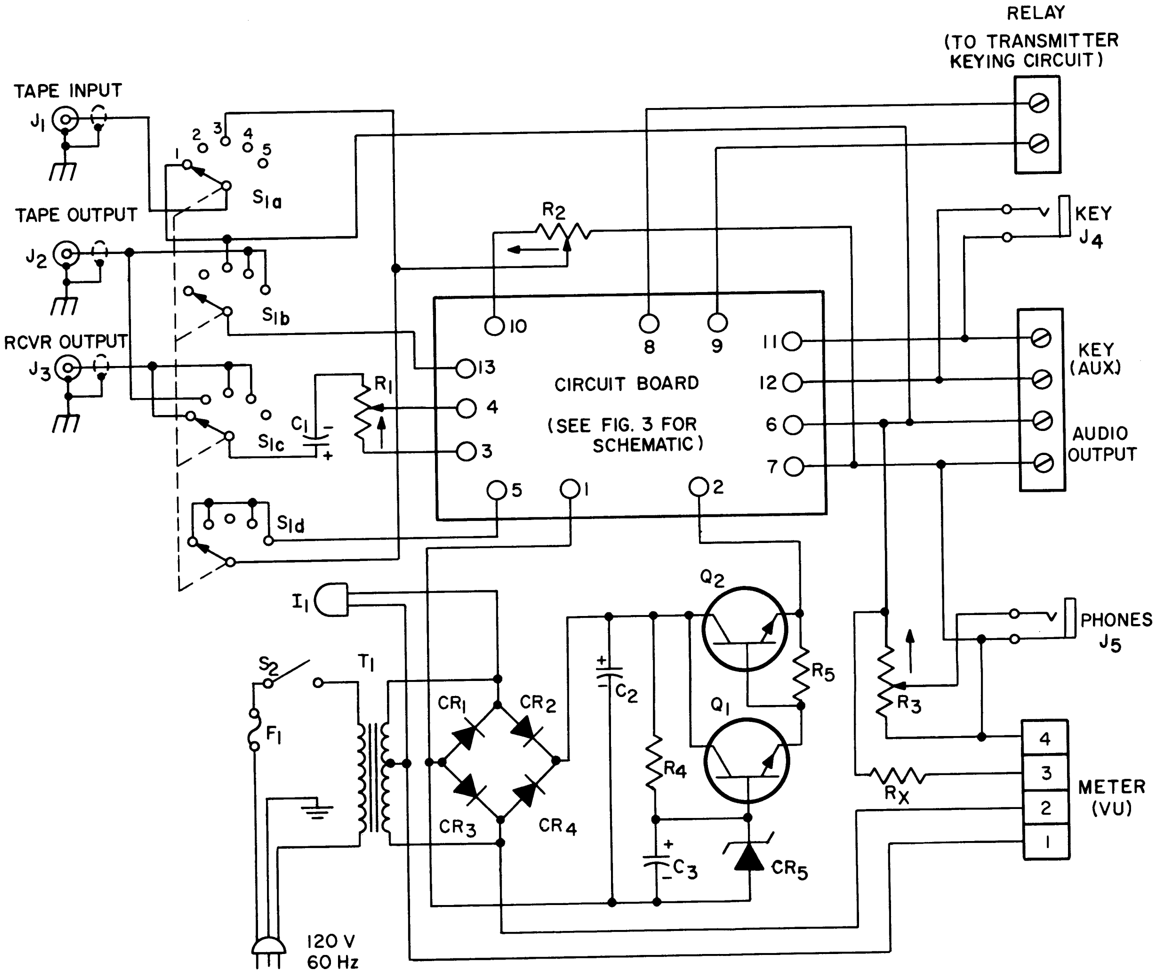


Figure 5: Completed Keyer with circuit board installed.



C$_1$ — 1 microfarad, 25 volts, electrolytic, for solid-state receivers; 0.5 microfarad, 400 volts, paper for tube-type receivers

C$_2$ — 1,000 microfarads, 25 volts, electrolytic

C$_3$ — 10 microfarads, 25 volts, electrolytic

CR$_1$, CR$_2$, CR$_3$, CR$_4$ — silicon rectifier, type 1N3193

CR$_5$ — zener diode, 15 volts, 1 watt

F$_1$ — fuse, 1 ampere, slo-blow type

I$_1$ — pilot-lamp assembly, No. 47 lamp

J$_1$, J$_2$, J$_3$ — RCA type phono jack

J$_4$, J$_5$ — single-circut phone jack

Q$_1$ — transistor, type 2N3242A

Q$_2$ — transistor, type 2N2102

R$_1$, R$_2$ — 10,000 ohms, linear potentiometer

R$_3$ — 2,500 ohms, linear potentiometer

R$_4$ — 330 ohms, ½ watt

R$_5$ — 220 ohms, ½ watt

R$_X$ — VU meter calibration resistor; will vary with meter

S$_1$ — rotary switch, 4-pole, 5-position

S$_2$ — toggle switch, SPST, 3 ampere rating

T$_1$ — filament transformer, 12.6 volts at 2 amperes

Figure 6: Schematic diagram and parts list of Keyer components not included on circuit board.

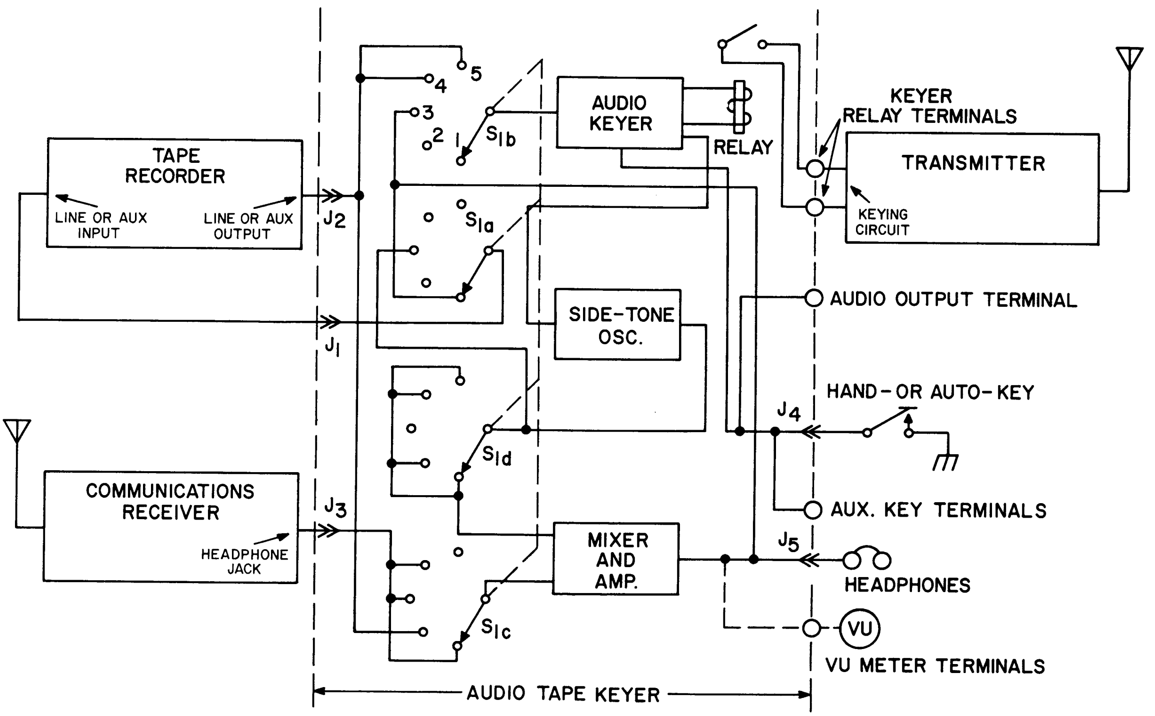


Figure 7: Interconnection diagram of W2YM keying system.

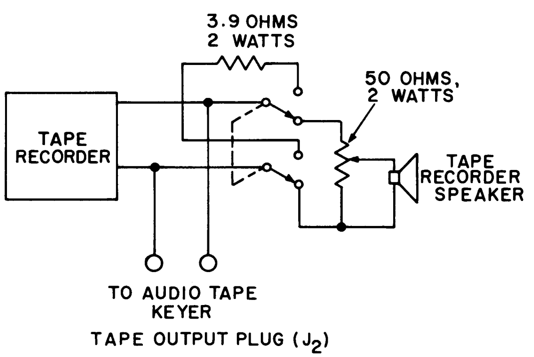


Figure 8: Required modification of tape recorder that has no "Line or Aux" output.

Again rewind the tape and set the "Selector" switch to position No. 4. In this setting, the receiver is connected to mixer input No. 1, and the side-tone oscillator is connected to the amplifier through mixer input No. 2. In addition, the "Line or Aux" output of the recorder is now connected to the input of the audio-keyer section of the Keyer. Position No. 4 of the "Selector" switch is the setting to be used to key a transmitter from a previously recorded tape. In this position, both incoming and outgoing signals may be heard and the transmitter may also be keyed manually.

To key the transmitter by tape, rewind the tape and adjust the output level of the tape recorder until the relay starts to operate and the side tone is heard in the headphones. Keying should be loud and clear. A signal of 1 to 3 volts is required at terminal No. 13 of the circuit board for satisfactory transmitter keying.

"Selector" switch position No. 5 is the

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same as position No. 4 except that incoming signals cannot be heard.

When the system is used for code instruction, the Keyer's "Selector" switch should be in position No. 4. A recording made at a tape speed of 7½ inches-per-minute and a code speed of 20 words-per-minute can be used to teach code at 10 words-per-minute by halving the playback tape speed to 3¾ inches-per-minute. For inexpensive recorders — in which tape speed is changed by manually changing the capstan — new capstans can be made that will permit transmission of code at almost any speed. The output of the amplifier in the Keyer is sufficient to drive up to 10 pairs of high-impedance headphones or to feed the "Line or Aux" input of any tape recorder.

Table I summarizes the functions of the Keyer in the various switch positions.

Remember, the W2YM magnetic-tape keying system can be used to equal advantage for voice recording and playback as well as for code keying. In the relatively short period since its installation, the author has used this system almost daily, and has found it extremely helpful in DX operation—epecially for the storage and replaying of weak-signal QSO's.

Table I — Keyer Functions

Selector Switch	Receive	Tape Key	Record	Playback	Monitor
Position #1	Yes	No	Yes	No	Incoming receiver signal and manually keyed side tone.
Position #2	No	No	No	Yes	Tape output and manually keyed side tone.
Position #3	Yes	No	Yes	No	Incoming receiver signal.
Position #4	Yes	Yes	No	No	Incoming receiver signal and manually- and tape-keyed side tone.
Position #5	No	Yes	No	No	Same as Position #4.

ham tips

January 1970 | Volume 30 Number 1

HAM-BAND CHARTS (Phase Two)

Covering FCC Allocations, Sub-Allocations, and Authorized Emissions from 3.5 to 450 MHz

By L. W. Aurick, K3QAX/W2QEX
RCA Electronic Components*

The ham-band charts and information contained in the May, 1969 issue of "Ham Tips" covered the first phase of the Federal Communications Commission's new amateur radio incentive license regulations. These regulations were adopted on November 22, 1967 and were placed into effect on November 22, 1968.

In this issue are revised data and charts that reflect the changes contained in the second phase of the new regulations. The second phase went into effect on November 22, 1969.

The purpose of the Federal Communications Commission in initiating the new regulations on a two-phase, two-year basis was to provide amateurs with an opportunity to adjust their operations to the new rules, as well as to attain one of the higher classes of license. The editors of "Ham Tips" plan to advise readers of any additional changes affecting amateur radio operations whenever such revisions are adopted.

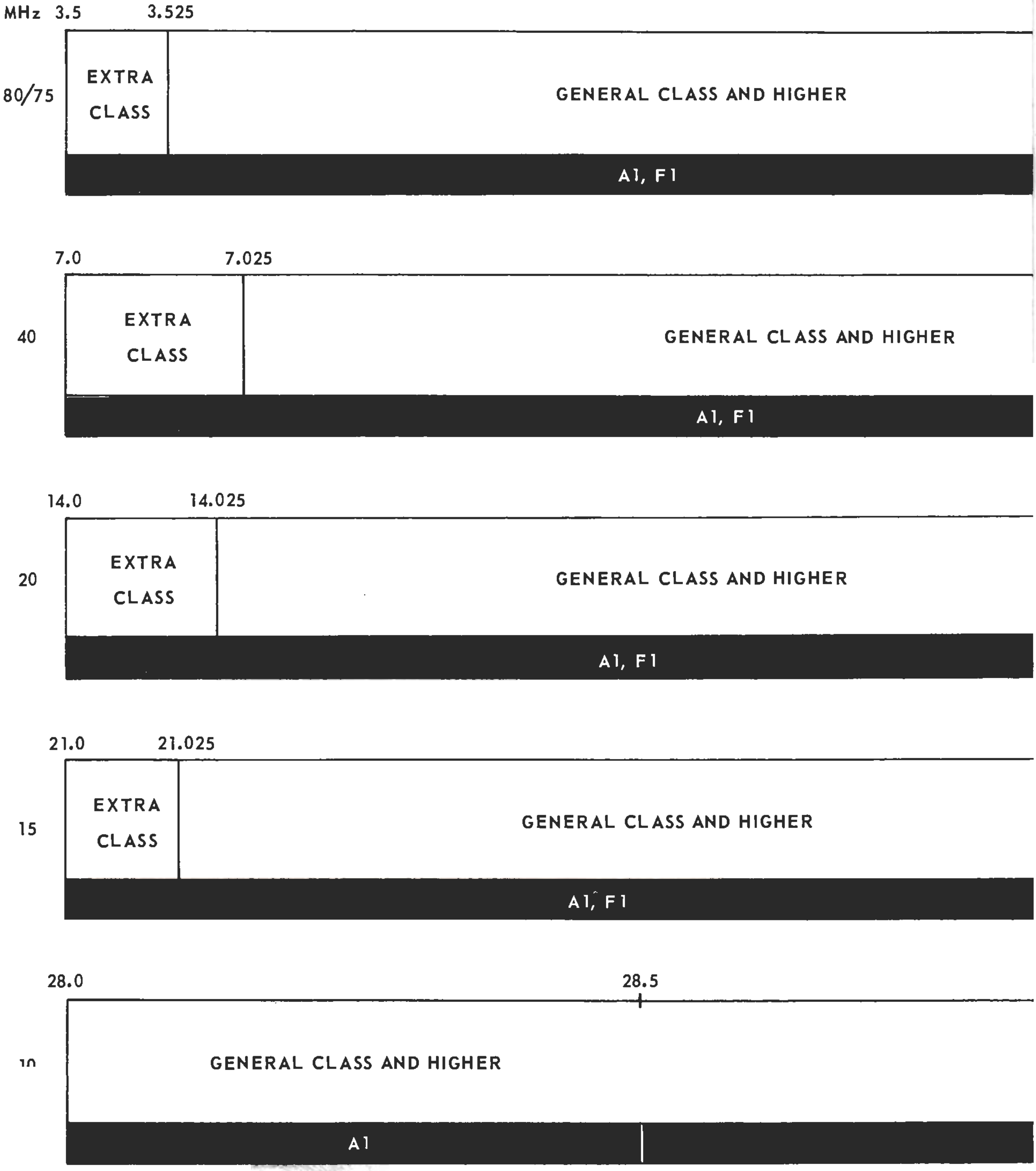
The second phase of the Federal Communications Commission's amateur radio incentive license regulations increases the size of the 'phone sub-allocations reserved for Extra and Advanced Class amateurs in the 75-, 40-, 20-, and 15-meter bands. The cw reservation for Extra Class amateurs remains at the first 25 kHz in the same bands.

Charts 1 and 2 cover all amateur frequency assignments up to 450 MHz, with the exception of the 1.8 to 2.0 MHz allocation. The 160-meter band is divided into eight "sub-bands," and operation in each of the 50 states and U.S. possessions is limited to a few of these. Maximum DC plate input power varies from day to night. A1 and A3 emissions are authorized, and there are no privileged segments. Because the regulations covering "top band" are subject to change without hearing (whenever the Commission shall determine such action necessary in view of the priority of the LORAN-A radionavigation system), it is suggested that interested amateurs consult

*Lancaster, Pennsylvania

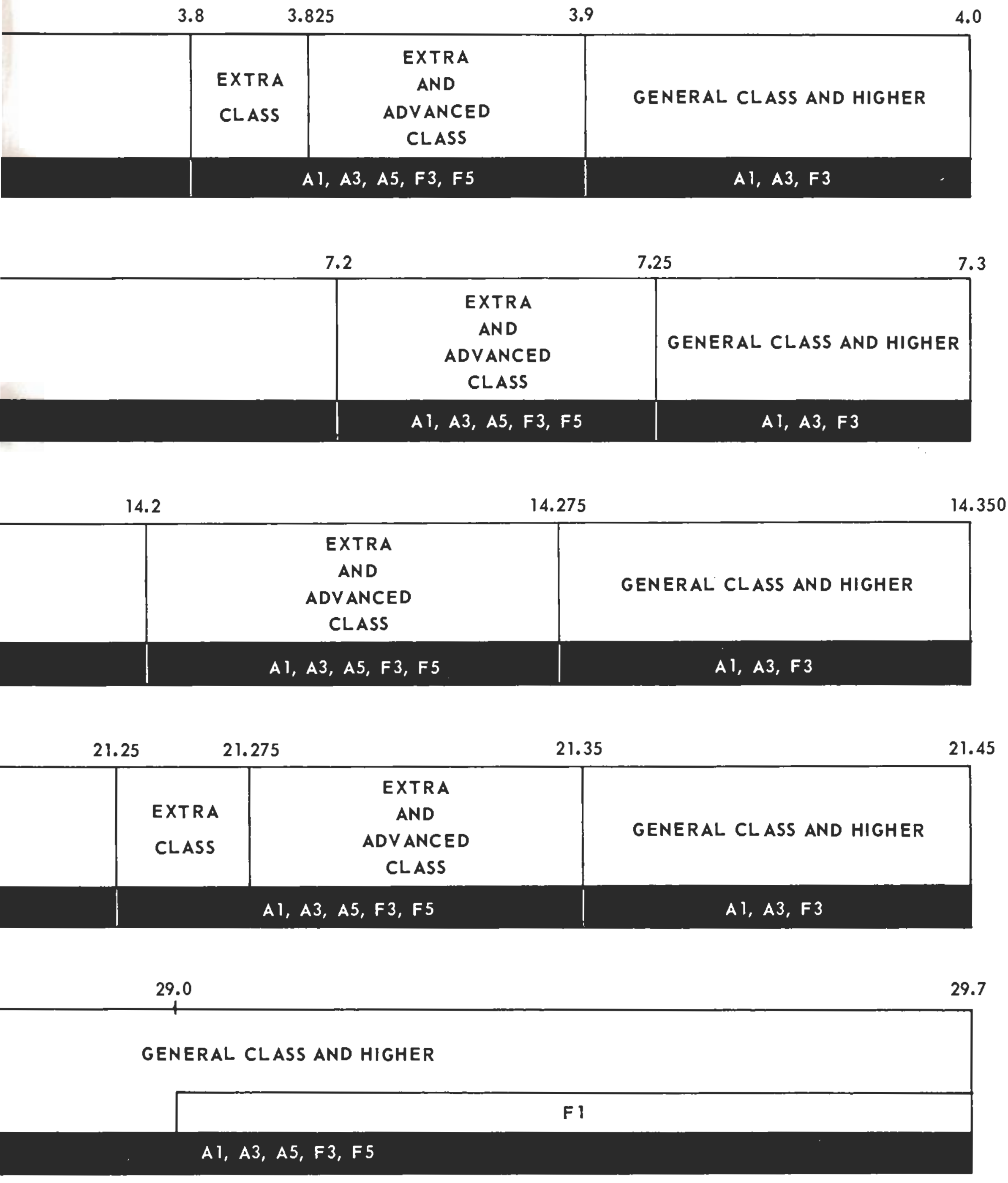
Chart 1: Am

(Showing Sub-Allocations and Autho



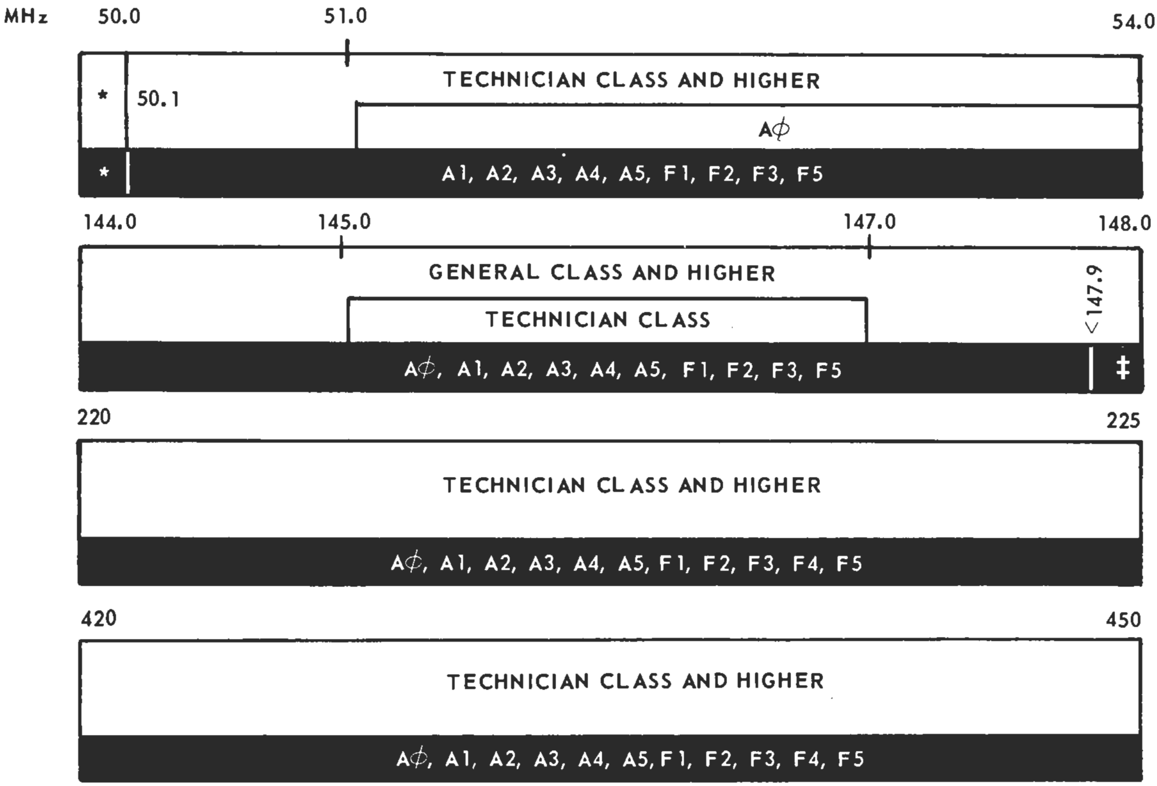
PLEASE NOTE: All data presented in the charts and text have been compiled from "FCC Rules and Regulations,'

ateur Bands
ized Emissions from 3.5 to 29.7 MHz)



Part 97, as of January 1, 1970.

Chart 2: Amateur Bands
(Showing Sub-Allocations and Authorized Emissions from 50 to 450 MHz)



* EXTRA AND ADVANCED CLASS – A1 ONLY

‡ GENERAL CLASS AND HIGHER – A1 ONLY

INDEX TO SYMBOLS USED IN CHARTS 1 AND 2

Showing Classification of All Emissions Authorized for Use by Amateurs Through 450 MHz

Type of Modulation	Type of Transmission	Symbol	Type of Modulation	Type of Transmission	Symbol
Amplitude	With no modulation	AØ	Frequency (or phase)	Telegraphy by use of shift keying without the use of a modulating audio frequency	F1
	Telegraphy without the use of modulating audio frequency (by on-off keying)	A1		Telegraphy by the on-off keying of a frequency-modulating audio frequency or by the on-off keying of frequency-modulated emission (Special Case: An unkeyed emission, frequency modulated)	F2
	Telegraphy by the on-off keying of an amplitude-modulating audio frequency or by the on-off keying of the modulated emission (Special Case: An unkeyed emission, amplitude-modulated)	A2		Telephony	F3
	Telephony	A3		Facsimile	F4
	Facsimile	A4		Television	F5
	Television	A5			

the nearest FCC District Office for details governing their particular area.

Because of their limited scope, Novice Class privileges are not shown. They are as follows: radiotelegraph (A1) operation only, 3.7 to 3.75 MHz; 7.15 to 7.2 MHz; 21.1 to 21.25 MHz; and 145.0 to 147.0 MHz — using all authorized radiotelegraph emissions.

Technician Class licensees may use all emissions authorized between 50.1 and 54.0 MHz and between 145.0 and 147.0 MHz, as well as all amateur frequencies and emissions authorized above 220.0 MHz.

Emission Limitations

Type AØ emission may be used for short periods of time, even where not specifically designated, for test and other experimental purposes.

On frequencies below 29.0 MHz and between 50.1 and 52.5 MHz, the bandwidth of an F3 emission may not exceed that of an A3 emission having the same audio characteristics.

On frequencies below 50.0 MHz, the bandwidth of A5 and F5 emissions may not exceed that of an A3 single-sideband emission.

On frequencies between 50.0 and 225.0 MHz, single-sideband or double-sideband A5 emission may be used but the bandwidth may not exceed that of an A3 single-sideband or double-sideband signal, respectively. The bandwidth of an F5 emission may not exceed that of an A3 single-sideband emission.

Below 225.0 MHz, A3 and A5 emissions may be used simultaneously on the same carrier frequency provided the total bandwidth does not exceed that of an A3 double-sideband emission.

In addition to the allocations shown here, amateurs may operate within six bands of frequencies from 1,215 to 22,000 MHz, as well as all frequencies above 40,000 MHz. Hams interested in any of these frequency assignments should consult "FCC Rules and Regulations," Part 97, for available operating privileges.

Except for voice-interrupted code practice, 50.1 MHz is the lowest frequency at which tone-modulated keying or facsimile modulation is permitted. Also, 51.0 MHz is the lowest frequency at which an unmodulated carrier (AØ) can be transmitted for other than short periods of test.

Amateur TV enthusiasts will note that A5 and F5 emissions of the slow-scan type are now authorized to Extra and Advanced Class amateurs on the bands between 3.8 and 21.35 MHz; to General Class and higher above 28.5 MHz; and to Technician Class Licensees between 50.1 and 54.0 MHz, 145.0 to 147.0 MHz, and 220.0 to 225.0 MHz. Above 420.0 MHz, the bandwidth restriction is eased for all licensees.

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August 1970 | Volume 30 Number 2

2- and 10-Meter Band Transceiver

A Practical, Simplified Approach to Module-Package Construction

By S. F. Dobrowolski, K2BBX
RCA Electronic Components*

Have you ever had to pass up a transceiver that was "just the ticket" for your ham shack, but too complicated to tackle as a construction project?

If so, here's another chance to get that rig you've been searching for — a transceiver you can build and put to work without being an electronics wizard.

K2BBX has come up with a complete construction package for a 2- and 10-meter unit that can be successfully assembled by the ham operator having only moderate know-how and bench experience.

Easy-to-follow instructions eliminate many of the problems and bottlenecks most frequently encountered by the average builder. Included in the package are detailed photographs, mechanical layouts, component-placement data, and a ready-made dial card for the receiver frequency scale. In brief, here's a terrific opportunity for the ham club that's seeking a transceiver for either a group project or for informative discussion and new ideas on related projects.

Sets of instructions are now in preparation and should be available by September. If you're interested in getting a set for your own ham group, write to: Commercial Engineering Department, Section "SD," RCA Electronic Components, Harrison, New Jersey 07029.

The following article is a general description of the K2BBX 2- and 10-meter band transceiver and its most important features.

Figure 1: View of completed K2BBX transceiver with RCA HK-99 Starmaker microphone. Unit measures 8 inches in height, 14 inches in width, and 10 inches in depth, and has a carrying handle for easy portability.

*Commercial Engineering, Harrison, New Jersey

Transceiver Features

- Push-to-talk operation
- Four meter positions
  ("S" meter, RF power output, final-amplifier grid current, and final-amplifier cathode current)
- Transmitter "spot" frequency in "receive" position
- Receiver sensitivity of less than 0.5 μV
- Minimal package density
  (less than 0.7 cubic foot)
- "Sectionalized" modular design for simplicity
- Front panel automatic noise limiter
- Five transmitter crystal positions
  (including a front-panel crystal socket for VFO or external-crystal operation)
- Front-panel jack for external speaker or earphones
- Front panel adjustable squelch circuit
- Efficient transmitter power output
  (7 watts on 2-meter band; 10 watts on 10-meter band)
- Additional Applications
  (ideal for local CD communications)

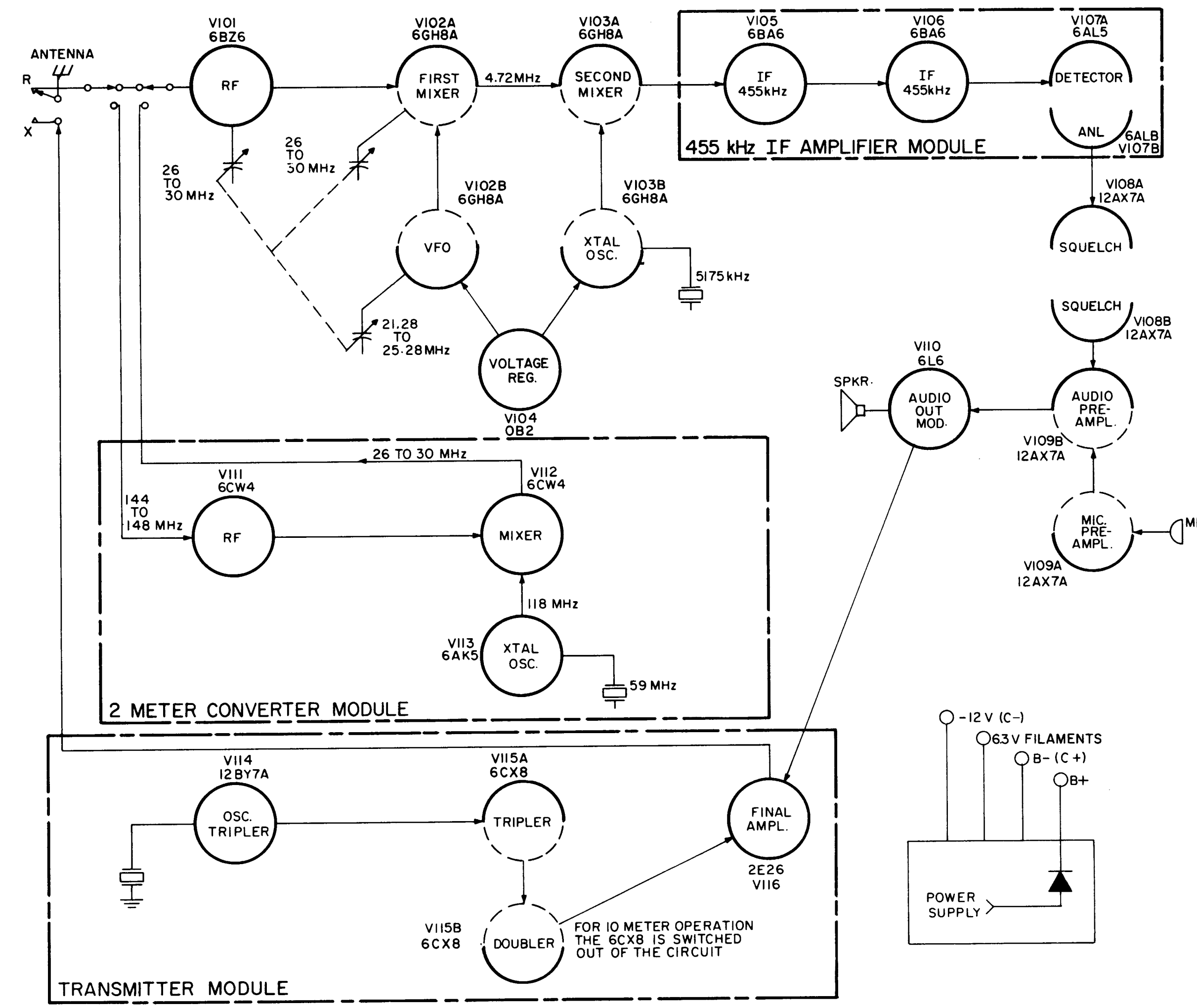

Figure 2: Block diagram of K2BBX 2- and 10-meter amateur-band transceiver.

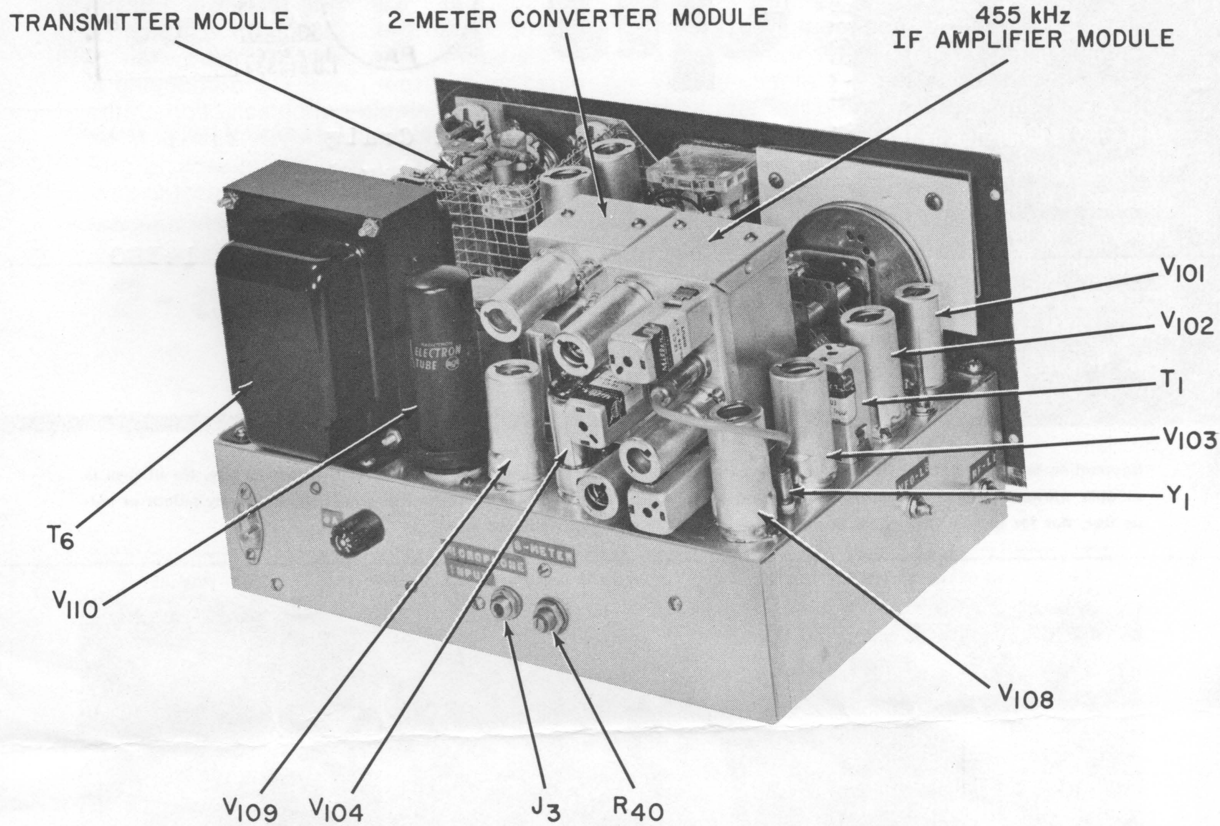

Figure 3: Interior rear view of transceiver showing layout of major components.

The K2BBX 2- and 10-meter amateur-band transceiver combines four major operating units in a compact, modular package approximately 8 inches high, 14 inches wide, and 10 inches deep. These four operating units consist of a main-chassis section containing the 10-meter receiver and power supply, a plug-in 455-kHz IF-amplifier module, a plug-in 2-meter converter module, and the transmitter module. Modular design eliminates many of the customary problems of wiring, and the total project is aided by the easy availability of reasonably priced components.

The 10-meter receiver is a double-conversion, superheterodyne type which covers the frequency range of 26 to 30 MHz with three tuned stages. Single-switch receiver operation connects a crystal-controlled 2-meter converter to the input of the 10-meter receiver. A frequency range of 144 to 148 MHz is tuned in the 2-meter "receive" position. The audio stages of the receiver function as the modulator-output, driver, and microphone-preamplifier stages.

The power supply consists of a single power transformer which provides a full-wave DC source for the high voltage, a 12-volt DC halfwave-bias supply, and a 6.3-volt AC filament supply.

The 455-kHz IF-amplifier module contains two IF-amplifier stages, an AM-diode detector stage, and a series-type automatic noise-limiter (ANL) stage.

The 2-meter converter module employs a 3-stage crystal-controlled circuit. Broadband characteristics are attained through the use of over-coupled, double-tuned circuits in the RF stages.

The transmitter module circuit incorporates three RF stages consisting of a crys-

tal-controlled oscillator-tripler stage, a dual-section tube which serves as a tripler-doubler stage, and a non-multiplying final-amplifier stage. For 10-meter transmission, a 9-MHz crystal is used — connecting only the oscillator-tripler and final-amplifier stages.

For 2-meter transmission, an 8-MHz crystal is used in conjunction with all multiplying stages in the circuit.

The transceiver is made operational through either a push-to-talk switch in the microphone-cable connection or through a single-operation transmit/receive switch located on the front panel. Band changing is facilitated by single-switch selection on the receiver and double-switch selection on the transmitter. A front-panel jack is provided for earphones and muting of the internal speaker.

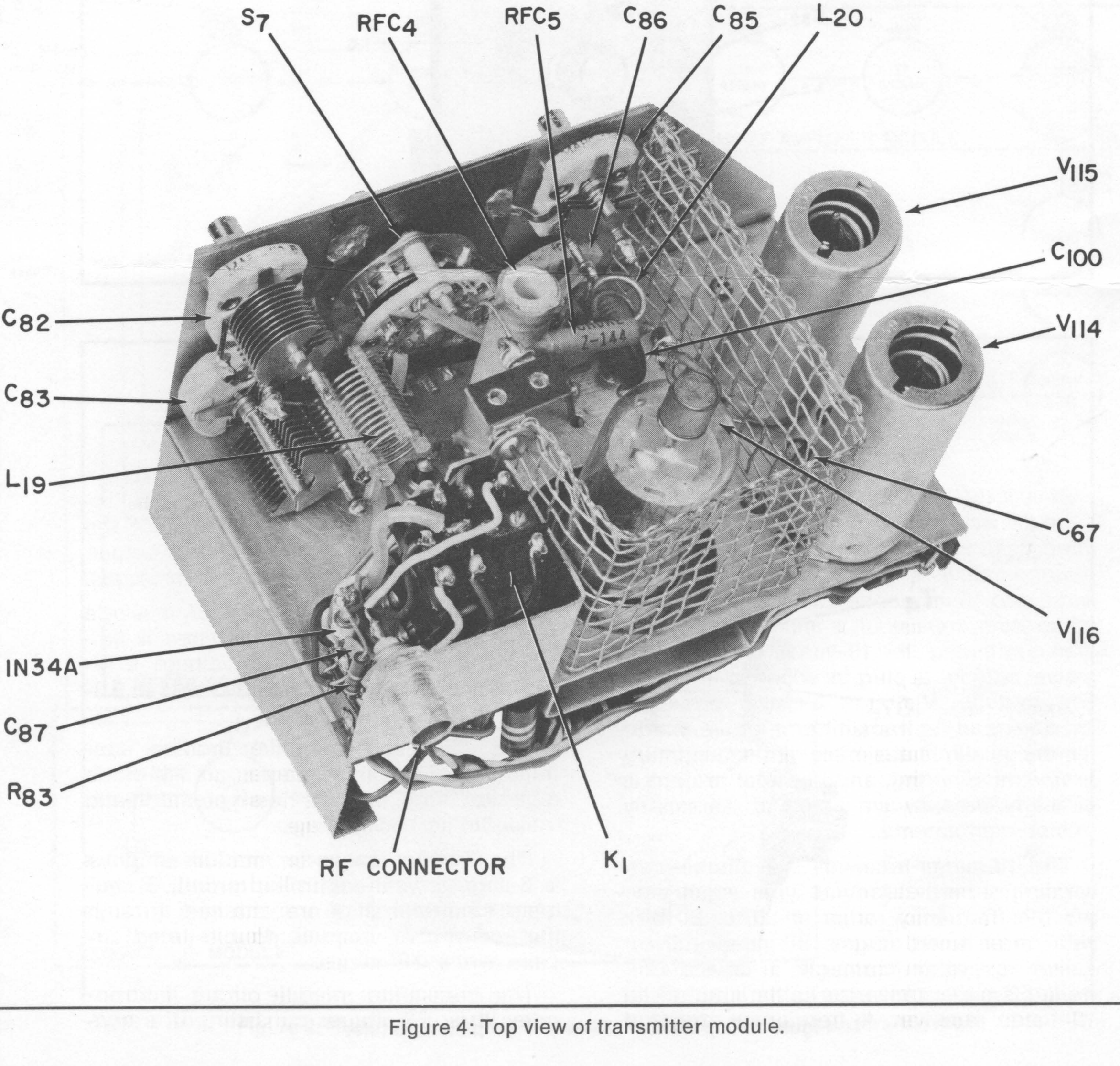

Figure 4: Top view of transmitter module.

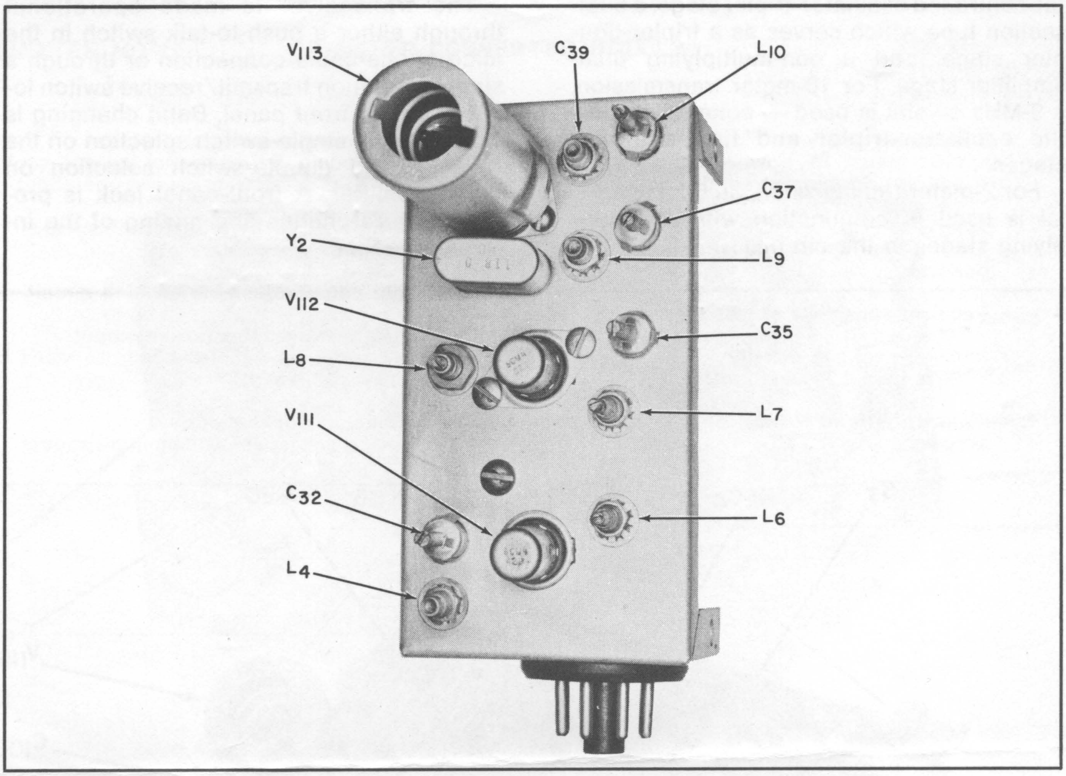

Figure 5: Top view of 2-meter converter module.

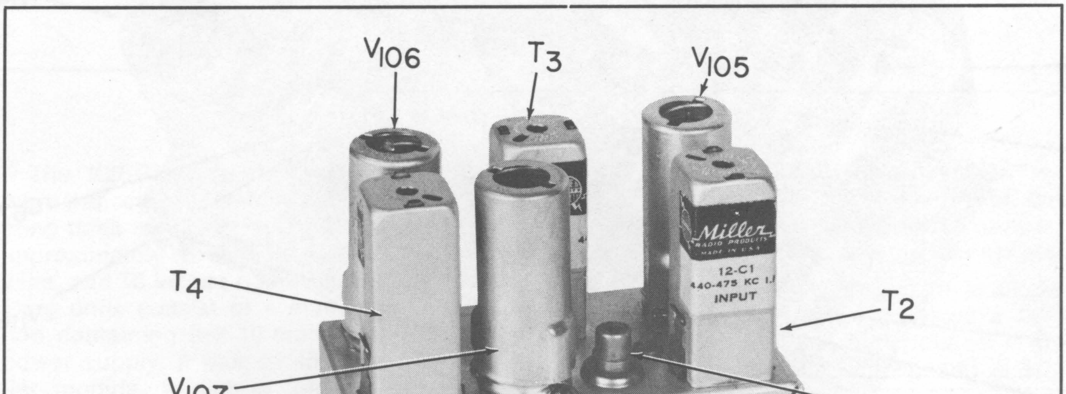

Figure 6: Top view of 455-kHz IF-amplifier module.

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